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Indian Standard

GUIDE FOR REQUIREMENTS AND TESTING OF ELECTRIC IRONS

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GUIDE FOR REQUIREMENTS AND TESTING OF ELECTRIC IRONS

0. FOREWORD

The general requirements and related methods of tests for electrical appliances are presently covered in IS 302 : 1979. Requirements of individual appliances are covered in a series of standards which make reference to IS 302 : 1979 wherever applicable. The small scale industry has expressed the need for a comprehensive document to cover all details in one publication even at the cost of repetition, for individual appliances, such as electric irons, electric immersion water heaters, electric stoves and electric radiators; to facilitate easy references for use of Indian Standards at the shop floor level. This special publication is prepared to meet this demand and covers electric irons.

In case of any deviations between the requirements of Guide and those specified in IS 366 : 1985, the provisions of the latter shall prevail upon and shall be applicable.

Assistance has been derived from the following Indian Standards while preparing this guide:

IS 302 : 1979 General and safety requirements for household and similar electrical appliances (*fifth revision*)

IS 366 : 1985 Specification for electric irons (*third revision*)

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1 SCOPE

1.1 This guide covers the general and safety requirements as well as procedures to conduct tests on electric irons used for household and similar purpose.

NOTE — For proper understanding wherever the word 'Appliance' appears, it would mean electric iron.

1.2 This guide does not apply to the following:

a) Rotary irons;
b) Irons intended to be used in vehicles or on board ships or aircraft;
c) Steam irons;
d) Spray irons; and
e) Irons intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas).

2 TERMINOLOGY

2.0 For the purpose of this guide, the following definitions shall apply. Where the terms voltage and current are used, they imply the rms values, unless otherwise specified.

2.1 Rated Voltage

The voltage (for three-phase supply, the voltage between phases) assigned to the appliance by the manufacturer.

2.2 Rated Voltage Range

The voltage range assigned to the appliance by the manufacturer, expressed by its lower and upper limits.

2.3 Rated Input

The input under conditions of adequate heat discharge or under normal load and at normal operating temperature, assigned to the appliance by the manufacturer.

2.4 Rated Current

The current assigned to the appliance by the manufacturer.

2.5 Rated Frequency

The frequency assigned to the appliance by the manufacturer.

2.6 Rated Frequency Range

The frequency range assigned to the appliance by the manufacturer, expressed by its lower and upper limits.

2.7 Power Supply Cord

A flexible cable or cord, for supply purposes, fixed to, or assembled with the appliance according to one of the following methods:

a) Type X attachment which denotes a method of attachment such that the flexible cable or cord may easily be replaced, without the aid of special purpose tools, by a flexible cable or cord not requiring any special preparation.

b) Type M attachment which denotes a method of attachment such that the flexible cable or cord may easily be replaced, without the aid of special purpose tools, by a special cable or cord with, for example, a moulded-on cord guard or crimped terminations.

c) Type Y attachment which denotes a method of attachment such that the flexible cable or cord can only be replaced with the aid of special purpose tools normally available only to the manufacturer or his agents.

NOTE — Type Y attachments may be used either with common flexible cables or cords or with special cables or cords.

d) Type Z attachment which denotes a method of attachment such that the flexible cable or cord cannot be replaced without breaking or destroying a part of the appliance.

2.8 Basic Insulation

An insulation applied to live parts to provide basic protection against electric shock.

NOTES

1 Basic insulation does not necessarily include insulation used exclusively for functional purposes.

2 The insulating properties of lacquer, enamel, ordinary paper, cotton, oxide film on metal parts, beads and sealing compound shall not be relied upon to give the required protection against accidental contact with live parts.

2.9 Supplementary Insulation

An independent insulation applied in addition to the basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation.

2.10 Double Insulation

An insulation comprising both basic insulation and supplementary insulation.

2.11 Reinforced Insulation

A single insulation system applied to live parts which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard.

NOTE — The term 'insulation system' does not imply that the insulation must be one homogeneous piece. It may comprise several layers which cannot be tested singly as supplementary or basic insulation.

2.12 Class I Appliance

An appliance in which protection against electric shock does not rely on basic insulation only, but includes an additional safety precaution in that accessible conductive parts are connected to the protective earthing conductor in the fixed wiring of the installation in such a way that accessible conductive parts cannot become live in the event of a failure of the basic insulation.

NOTES

1 Class I appliances may have parts with double insulation or reinforced insulation, or parts operating at safety extra-low voltage.

2 For appliances intended for use with a flexible cord or cable, this provision includes a protective conductor as part of the flexible cord or cable.

2.13 Class II Appliance

An appliance in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation, are provided, there being no provision for protective earthing or reliance upon installation conditions.

Such an appliance may be one of the following types:

a) An appliance having a durable and substantially continuous enclosure of insulating material which envelops all metal parts, with the exception of small parts, such as name plates, screws and rivets, which are isolated from live parts by insulation at least equivalent to reinforced insulation; such an appliance is called an insulation-encased Class II appliance.

b) An appliance having a substantially continuous metal enclosure, in which double insulation is used throughout, except for those parts where reinforced insulation is used, because the application of double insulation is manifestly impracticable; such an appliance is called a metal-encased Class II appliance.

c) An appliance which is a combination of the Types (a) and (b) above.

NOTES

1 The enclosure of an insulation-encased Class II appliance may form a part or the whole of the supplementary insulation or of the reinforced insulation.

2 If an appliance with double insulation and/or reinforced insulation throughout has an earthing terminal or earthing contact, it is considered to be Class I construction.

3 Class II appliances may have parts operating at safety extra-low voltage.

2.14 Class III Appliance

An appliance in which protection against electric shock relies on supply at safety extra-low voltage and in which voltages higher than those of safety extra-low voltage are not generated.

NOTE — Appliances intended to be operated at safety extra-low voltage and having internal circuits which operate at a voltage other than safety extra-low voltage. are not included in the classification and are subject to additional requirements; these requirements are under consideration.

2.15 Extra-Low Voltage

A voltage supplied from a source within the appliance and, when the appliance is operated at its rated voltage, not exceeding 32 V between conductors and between conductors and earth or, for three-phase supply, not exceeding 18·5 V between conductors and neutral, the extra-low voltage circuit being separated from other circuits by basic insulation only.

2.16 Low Voltage

A voltage not exceeding 250 V under normal conditions.

2.17 Medium Voltage

A voltage exceeding 250 V but not exceeding 650 V under normal conditions.

2.18 Safety Extra-Low Voltage

A nominal voltage not exceeding 32 V between conductors and between conductors and earth or, for three-phase supply, not exceeding 18·5 V between conductors and neutral, the no-load voltage not exceeding 38 V and 22 V respectively.

NOTES

1 When safety extra-low voltage is obtained from the supply mains, it must be through a safety isolating transformer or a convertor with separate windings.

2 The voltage limits specified are based on the assumption that the safety isolating transformer is operated at its rated supply voltage.

2.19 Safety Isolating Transformer

A transformer, the input winding of which is electrically separated from the output windings by an insulation at least equivalent to double insulation or reinforced insulation, and which is designed to supply a distribution circuit, an appliance or other equipment at safety extra-low voltage.

2.20 Portable Appliance

Either an appliance which is moved while in operation or an appliance which may easily be moved from one place to another while connected to the supply.

2.21 Hand-Held Appliance

A portable appliance intended to be held in the hand during normal use, the motor, if any, forming an integral part of the appliance.

2.22 Conditions of Adequate Heat Discharge

The conditions that apply when a heating appliance is operated under normal conditions of use.

2.23 Continuous Operation

Operation under normal load or in accordance with conditions of adequate heat discharge for an unlimited period.

2.24 Detachable Part

A part which can be removed without the aid of a tool.

2.25 Thermostat

A temperature-sensing device, the operating temperature of which may be either fixed or adjustable, and which, during normal operation, keeps the temperature of an appliance, or of parts of it, between certain limits by automatically opening and closing a circuit.

2.26 Temperature Limiter

A temperature-sensing device, the operating temperature of which may be either fixed or adjustable, and which, during normal operation, operates by opening or closing a circuit when the temperature of an appliance or of parts of it, reaches a predetermined value.

NOTE — It does not make the reverse operation during the normal duty cycle of the appliance. It may or may not require manual resetting.

2.27 Thermal Cut-Out

A device which, during abnormal operation, limits the temperature of an appliance or of parts of it, by automatically opening the circuit or by reducing the current, and which is so constructed that its setting cannot be altered by the user.

2.28 Self-Resetting Thermal Cut-Out

A thermal cut-out which automatically restores the current after the relevant part of the appliance has cooled down sufficiently.

2.29 Non-self-Resetting Thermal Cut-Out

A thermal cut-out which requires resetting by hand, or replacement of a part, in order to restore the current.

2.30 Tool

A screwdriver, a coin or any other object which may be used to operate a screw or similar fixing means.

2.31 Creepage Distance

The shortest path between two conductive parts, or between a conductive part and the bounding surface of the appliance, measured along the surface of the insulating material.

2.32 Clearance

The shortest distance between two conductive parts, or between a conductive part and the bounding surface of the appliance, measured through air.

NOTE — The bounding surface of the appliance is the outer surface of the enclosure, considered as though metal foil were pressed into contact with accessible surfaces of insulating material.

2.33 All-Pole Disconnection

For single-phase ac appliances and for dc appliances, disconnection of both supply conductors by a single switching action or, for appliances to be connected to more than two supply conductors, disconnection of all supply conductors, except the earthed (grounded) conductor, by a single switching action.

NOTE — The protective earthing conductor is not considered to be a supply conductor.

2.34 Visibly Glowing Heating Element

A heating element which, when the appliance is assembled ready for use, is partly or completely visible from the outside of the appliance, and the temperature of which is at least 650°C after the appliance has been operated in accordance with conditions of adequate heat discharge until steady conditions have been established, the supply voltage being such that the input is equal to the minimum rated input.

NOTE — This definition is mainly intended for testing with test probes regarding accessibility of live parts.

2.35 Accessible Parts or Accessible Surface

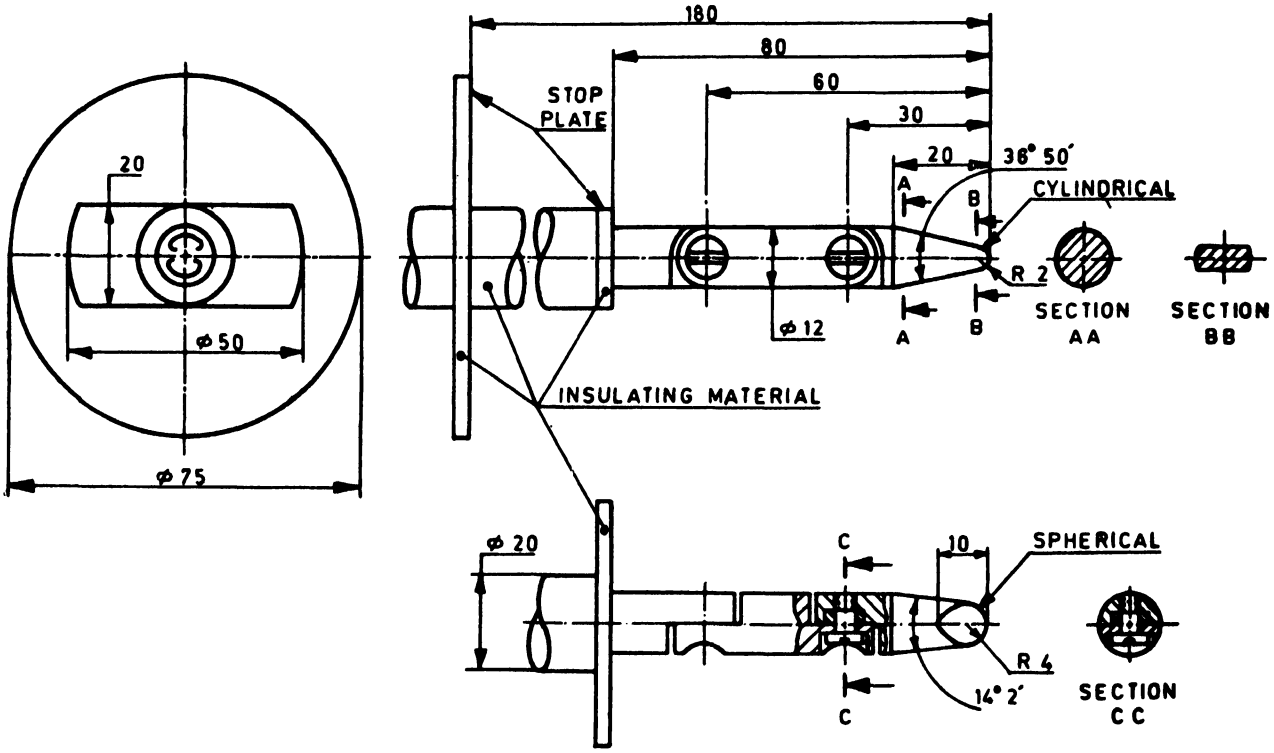
A live part or a live surface which can be touched by means of the standard test finger shown in Fig. 1.

2.36 Body

The term includes all accessible metal parts, shafts of handles, knobs, grips and the like and metal foil in contact with all accessible surfaces of insulating material; it does not include inaccessible metal parts.

2.37 Steady State Condition

The steady state condition is considered to have been reached when the difference between two consecutive readings of temperature-rise over the ambient taken at half an hour interval has not exceeded 1°C.



Both joints of this finger may be bent through an angle of 90°, but in one and the same direction only.

Tolerances :

On angles : ± 5°

On linear dimensions :

Less than 25 mm : $^{+0}_{-0·5}$

Over 25 mm : ± 0·2

All dimensions in millimetres.

FIG. 1 STANDARD TEST FINGER

2.38 Type Tests

Tests carried out to prove conformity with the requirements of the standard. These are intended to prove the general qualities and design of a given type of appliance.

2.39 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

2.40 Routine Tests

Tests carried out on each item to check the essential requirements which are likely to vary during production.

2.41 Electric Irons

A portable appliance, which has an electrically heated sole plate and is used for ironing textile material.

2.42 Thermostatic Iron

An iron fitted with a thermostat, the setting of which may be adjusted manually to alter the sole plate temperature over a range and maintain it within certain limits.

2.43 Iron with Self-Resetting Thermal Cut-Out

An iron fitted with a self-resetting thermal cut-out with a fixed setting to limit the maximum temperature of the sole plate.

2.44 Iron with Non-self-Resetting Thermal Cut-Out

An iron fitted with a non-self-resetting cut-out, such as a fusible link for disconnecting the heating element, if the iron attains excessive temperature.

2.45 Dry Iron

An iron having neither means to produce and supply steam nor to spray water on the textile material while ironing.

2.46 Sole Plate

The flat surface of the iron, which is heated electrically and pressed against textile material while ironing.

2.47 Mid-Point

The mid-point of the sole plate of an electric iron is the point on the centre line of the sole plate surface, midway between the tip and the head of the iron.

2.48 Stand

The stand of an electric iron is the separate stand, if one is delivered with the iron, otherwise it is the head stored or similar incorporated device.

2.49 Automatic Iron

An electric iron fitted with temperature control device, the setting of which can be adjusted manually to alter the sole plate temperature over a range and maintained within certain limits.

NOTE — Electric iron with a thermal cut-out is not treated as an automatic iron.

3 SAFETY PRECAUTIONS

3.1 Before testing the electric iron, it should be checked for the possible mechanical defects and electrical connections. The purpose of this check is to ascertain the absence of defects which may:

a) harm the electric iron during the test,
b) hinder the proper operation of the electric iron, and
c) result in safety hazards to the testing personnel.

3.2 Safety precautions shall be taken for all the tests for access of current and heat encountered. All tests shall be performed by experienced personnel only.

4 GENERAL NOTES ON TESTS

4.1 The type tests on electric iron are carried out on two samples as delivered which shall withstand all the relevant tests.

NOTES

1 If it is evident from the design of the appliance that a particular test is not applicable, it shall not be conducted.

2 If the appliance is designed for different supply voltage; both for ac and dc; more than two samples shall be tested.

3 If it is necessary to dismantle a Class II appliance for the relevant tests, one additional sample shall be required.

4 The testing of components may necessitate the submission of additional samples of these components. When the submission of such samples is necessary, they should be submitted together with the appliance.

4.2 The tests are carried out in the order of the clauses except that:

a) the test for the provision of a stand which is attached or incorporated or be delivered with a separate stand, compliance of which is checked by inspection and is done before carrying out the temperature-rise test.
b) Test for measurement of heating up time, measurement of sole plate temperature, measurement of temperature distribution, measurement of initial overswing temperature and heating up excess temperature, measurement of cyclic fluctuation of temperature of the hottest point and temperature drop under load are made before the endurance test.

4.3 The tests are carried out with the appliance, or any movable part of it, placed in the most unfavourable position which may occur in normal use.

4.4 If the test results are influenced by the temperature of the ambient air, the room temperature, in general, is maintained at 27 ± 5°C. If, however, the temperature attained by any part is limited by a temperature sensitive device, or is influenced by the temperature at which a change of state occurs, for example, the temperature of boiling water, the room temperature, in case of doubt, is maintained at 27 ± 2°C and a relative humidity of 65 ± 5 percent.

4.5 Appliances for ac only are tested with ac, at rated frequency, if marked. Those for dc only are tested with dc and those for ac/dc are tested at the more unfavourable supply.

Appliances for ac which are not marked with rated frequency are tested at 50 Hz.

Appliances marked with a rated frequency range shall be tested at the most unfavourable frequency within the range.

Appliances designed for more than one rated voltage shall be tested at the most unfavourable voltage.

4.6 Unless otherwise specified, appliances designed for one or more rated voltage ranges are tested at the most unfavourable voltage within the relevant range(s).

NOTE — Where reference is made to maximum or minimum rated input, the rated input related to the upper limit or lower limit respectively of the rated voltage range is meant.

4.7 Appliances provided with a thermostat, a regulating device or a similar control, are tested with these controls adjusted to their most unfavourable setting, if the setting can be altered by the user.

NOTE — If the adjusting means of the control is accessible without the aid of a tool, the provisions apply whether the setting can be altered by hand or with the aid of a tool; if the adjusting means is not accessible without the aid of a tool, the provisions apply only if the setting can be altered by hand.

Adequate sealing is regarded as preventing alteration of the setting by the user.

4.8 Unless otherwise specified, appliances intended to be supplied by means of a flexible cable or cord are tested with the appropriate flexible cable or cord connected to the appliance. In case plug ~~is~~ not provided with the flexible cable or cord, plug of appropriate rating shall be fitted for the purpose of conducting the tests.

4.9 When, for heating appliances, it is specified that the appliance has to be supplied at a voltage such that the input is greater than the rated input, this voltage applies only to heating elements without appreciable positive temperature coefficient of resistance. This voltage is determined as follows:

> 'First, the rated voltage is supplied until the heating element reaches its operating temperature. The supply voltage is then rapidly increased to the value necessary to give the input required for the relevant test and the test is made as specified, the value of the supply voltage being maintained throughout the test.'

NOTE — In general, the temperature coefficient is considered to be appreciable if, at rated voltage the input of the appliance in cold condition differs by more than 25 percent from the input at operating temperature.

4.10 Measuring Instruments

The measurement of voltage, current and power shall be carried out with such instruments which do not themselves appreciably effect the values to be measured. The meters employed shall be of accuracy Class I or better according to relevant parts of IS 1248 series.

4.11 The following are the conditions under which the appliance is operated:

a) Iron with a thermostat is operated with the thermostat at the highest setting; other irons are operated so that the temperature at the centre of the sole plate is maintained at 250 ± 10°C by switching on and off;

b) Irons are operated on their stand; which may be attached or incorporated in the stand.

5 RATING

5.1 The rated voltage shall not exceed 250 V. The preferred value shall be 240 V.

5.2 The rating in watts should preferably be chosen from the following:

450 W, 600 W, 750 W, 1 000 W.

6 CLASSIFICATION

6.1 The electric irons are classified according to:

a) protection against electric shock— Class I appliances, and

b) degree of protection against moisture — ordinary appliances.

NOTE — The class numbers are not intended to reflect the safety level of the appliances, but only the means by which the safety is obtained.

7 MARKING

7.1 Electric irons shall be marked with the following information:

a) Indication of the source of manufacture;

b) Rated voltage in volts;
c) Rated input in watts; and
d) Country of manufacture.

7.2 When symbols are used, they shall be as follows:

V	volts
A	amperes
Hz	hertz
W	watts
~	alternating current
kg	kilograms

The symbol for nature of supply shall be placed next to the marking for rated voltage.

7.3 Terminals intended exclusively for the neutral conductor shall be indicated by the letter 'N'.

Earthing terminals shall be indicated by the symbol ⏚

These indications shall not be placed on screws, removable washers or other parts which might be removed when conductors are being connected.

7.4 The different positions of regulating devices and the different positions of switches on stationary appliances shall be indicated by figures, letters or other visual means.

If figures are used for indicating the different positions, the 'off' position shall be indicated by the figure '0' and the position for a greater output, input, speed, cooling effect, etc, shall be indicated by a higher figure.

The figure '0' shall not be used for any other indication.

7.5 Thermostats, regulating devices and the like, intended to be adjusted during installation or in normal use, shall be provided with an indication for the direction of adjustment to increase or to decrease the value of the characteristic being adjusted.

NOTE — An indication of + and — is considered to be sufficient.

7.6 For electric iron marked with more than one rated voltage or voltage range, the rated input for each of these voltages or range shall be marked.

The upper and lower limits of the rated input shall be marked on the electric iron so that the relation between input and voltage appears distinctly unless the difference between the limits of a rated voltage range does not exceed 10 percent of the mean value of the range in which case the marking for rated input may be related to the mean value of the range.

7.7 An instruction sheet giving the following instructions shall be provided with each electric iron:

a) Precautions to be taken for the proper use of electric iron; and
b) In case an insulation sleeve is provided over the insulation of the supply cord, instructions to the effect that while replacing the supply cord, an insulation sleeve made of fibre glass or equivalent material should be used over the cable insulation.

7.8 Marking required by this standard shall be legible and durable.

Marking specified in **7.1** to **7.3** shall be on a main part of the electric iron.

Marking on, and indications for switches thermostats, thermal cut-outs and other control devices shall be placed in the vicinity of these components; they shall not be placed on removable parts if these parts can be replaced in such a way that the marking is misleading.

Compliance is checked by inspection and by rubbing the marking by hand for 15 seconds with a piece of cloth soaked with water and again for 15 seconds with a piece of cloth soaked with petroleum spirit.

After all the tests of this standard, the marking shall be easily legible, it shall not be easily possible to remove marking plates and they shall show no curling.

In considering the durability of the marking, the effect of normal use is taken into account. Thus, for example, marking by means of paint or enamel other than vitreous enamel on containers that are likely to be cleaned frequently is not considered to be durable.

8 PROTECTION AGAINST ELECTRIC SHOCK

8.1 Electric iron shall be so constructed and enclosed that there is adequate protection against accidental contact with live parts.

The insulating properties of lacquer, enamel, ordinary paper, cotton, oxide film on metal parts, beads and sealing compound shall not be relied upon to give the required protection against accidental contact with live parts.

The enclosure of electric iron shall have no openings other than those necessary for the use and working of the appliance, giving access to live parts.

NOTE — If a manufacturer instructs the user to remove a part during normal operation or user maintenance, that part is regarded as a detachable par even if a tool has to be used for its removal.

Compliance is checked by inspection and test with the standard test finger shown in Fig. 1.

8.2 In addition, apertures in Class I appliances, other than those in metal parts connected to an earthing terminal or earthing contact are tested with the test pin shown in Fig. 2. The test finger and the test pin are applied, without appreciable force, in every possible position.

8.2.1 For electric iron provided with movable devices, such as those intended for varying the heat distribution the test is made with the devices adjusted to their most unfavourable position within their range of adjustment.

Apertures preventing the entry of the finger are further tested by means of a straight jointless test finger of the same dimensions, which is applied with a force of 20 N; if this finger enters, the test with the finger shown in Fig. 1 is repeated, the finger being introduced through the aperture. If the unjointed test finger does not enter, the force applied is increased to 30 N. If then the guard is so displaced or the aperture so distorted that the test finger shown in Fig. 1 can be inserted without force, the test with the latter finger is repeated. An electrical contact indicator is used to show contact.

It shall not be possible to touch bare live parts or live parts protected by lacquer, enamel, ordinary paper, cotton, oxide film, beads or sealing compound only, with the test finger. In addition, it shall not be possible to touch bare live parts with the test pin when testing apertures as indicated above.

NOTES

1 The standard test finger must be so designed that each of the jointed sections can be turned through an angle of 90° with respect to the axis of the finger in the same direction only.

2 It is recommended that a lamp be used for the indication of contact with live parts and the voltage rating of the lamp shall be in the range of 40 to 75 volts.

8.2.2 Electric iron handles and knobs which are held or actuated in normal use shall not become live in the event of an insulation fault. If these handles, levers or knobs are of metal and if their shaft or fixings are likely to become live in the event of an insulation fault, they shall either be adequately covered by insulating material or their accessible parts shall be separated from their shafts or fixings by supplementary insulation.

Compliance is checked by inspection.

8.2.2.1 Handles, which in normal use, are continuously held in the hand shall be so constructed that when gripped as in normal use, contact between the operator's hand and metal parts which may become live in the event of an insulation fault is unlikely.

Compliance is checked by inspection.

9 INPUT

9.1 The input of the electric iron at rated voltage and at normal operating temperature shall not deviate from the rated input by more than ± 10 percent.

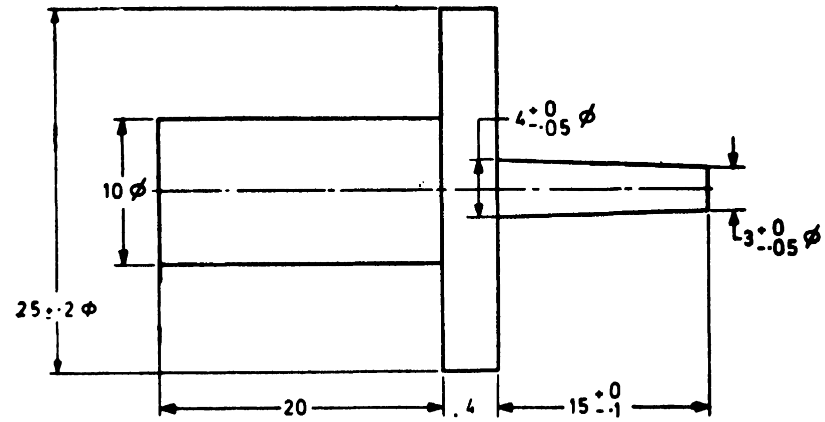
Compliance is checked by measuring the input of the electric iron, operated at rated voltage and in accordance with conditions of adequate heat discharge.

NOTE — For electric iron marked with a rated voltage range having limits differing by more than 10 percent of the mean value of the range, the permissible deviations apply for both limits of the range.

10 TEMPERATURE-RISE

10.1 Electric iron and their surroundings shall not attain excessive temperatures in normal use.

Compliance is checked by determining the temperature rise of the various parts under the conditions specified in **10.2** to **10.5**.



All dimensions in millimetres.

FIG. 2 TEST PIN

10.2 Electric iron is placed in a test corner and operated for 30 minutes. The test corner consists of two walls at right angles, a floor and, if necessary, a ceiling, all of dull-black painted plywood having a thickness of 20 mm. The appliance is positioned in the test corner as follows:

Electric iron is placed on the floor of the test corner at a distance of about 15 cm from the walls of the test corner.

NOTE — This distance includes the natural projections such as bolts, appliance inlets, etc, of the electric iron.

10.3 Temperature-rises are determined by means of the fine wire thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.

Thermocouples used for determining the temperature-rise of the surface of walls, ceiling and floor are embedded in the surface or attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick, which are flush with the surface.

So far as is possible, the appliance is positioned so that parts likely to attain the highest temperatures touch the disks.

10.3.1 In determining the temperature-rises of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and if of insulating material, to parts in contact with hot metal.

10.3.2 The temperature-rise of the internal wiring is taken over the insulation or the insulation sleeve (of fibre glass or equivalent material) where the same has been provided over the insulation of the supply cord.

10.4 Electric iron is operated for a period of 30 minutes, in accordance with conditions of adequate heat discharge, with all heating elements in circuit, the supply voltage being such that the input is 1·15 times the maximum rated input.

10.5 During the test, thermal cut-outs shall not operate, the temperature-rises shall not exceed the values shown in Table 1 and sealing compound, if any, shall not flow out.

Table 1 Temperature-Rise

Rubber insulation of internal and external wiring including power supply cords:	35°C
Handles, grips and the like which, in normal use, are continuously held (moulded material)	35°C
Pins of appliance inlets:	
for hot conditions	115
for cold conditions	25
Knobs, grips and the like which, in normal use, are held for short periods only (moulded material)	45°C

11 OPERATION UNDER OVERLOAD CONDITIONS

11.1 Electric iron shall be so designed and constructed that they withstand overloads liable to occur in normal use.

In particular, heating wires, internal wiring and the general assembly shall not show such deformation that creepage distances and clearances are reduced below the values specified. Contacts and connections shall not have worked loose.

Electric iron is placed on a horizontal support, away from walls.

11.2 The electric iron is subjected to 15 cycles, each cycle comprising an operating period until steady conditions are established in accordance with conditions of adequate heat discharge, and a cooling period sufficient to allow the appliance to cool down to approximately room temperature.

Throughout the operating period, the supply voltage being such that the input is:

1·27 times the rated input or 1·21 times the rated input plus 12 W, whichever is greater.

If a self-resetting thermal cut-out or a non-self-resetting thermal cut-out which is accessible and can be reset without the aid of a tool, the operating period is considered to be ended. The appliance is then allowed to cool down and the cut-out is reset for the next cycle.

During the test, non-self-resetting thermal cut-outs which are only accessible with the aid of a tool or which require the replacement of a part shall not operate and no vapour or ignitable gas shall accumulate in the appliance.

NOTE — Forced cooling may be used for the purpose of shortening the cooling period.

12 ELECTRICAL INSULATION AND LEAKAGE CURRENT AT OPERATING TEMPERATURE

12.1 The electrical insulation of the appliance at operating temperature shall be adequate and the leakage current in normal use shall not be excessive.

12.2 Compliance is checked by the leakage current test and high-voltage test. The electric iron is operated under the condition of adequate heat discharge under normal load until a steady condition is established.

The electric iron is operated at the supply voltage being such that the input is 1·15 times the maximum rated input. The tests are made while the appliance is connected to the supply.

12.3 Leakage Current Test

The leakage current is measured between any pole of the supply, and accessible metal parts. The measuring circuits shall be as per Fig. 3.

The resistance of the measuring circuit is 2 000 ± 100 Ω.

The test is made with ac, unless the appliance is for dc only, in which case the test is made with dc.

The leakage current which may flow from the live parts to the accessible metal parts shall not exceed 300 μA (peak), that is, 210 μA (rms).

NOTE — Appliance shall be well insulated from earth during leakage current measurements. Earthing connections shall not be made during the leakage current test.

12.4 High Voltage Test

12.4.1 The insulation is subjected for one minute to a voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz. The connections are as shown in Fig. 4. The test voltage is applied between live parts and the body.

12.4.2 The value of the test voltage is:

500 V for basic insulation subjected in normal use to a safety extra-low voltage;

1 000 V for other basic insulation;

2 750 V for supplementary insulation; and

3 750 V for reinforced insulation.

12.4.3 Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test. Glow discharges without drop in voltage are neglected.

The high voltage transformer used for the test has a rating of at least 500 VA.

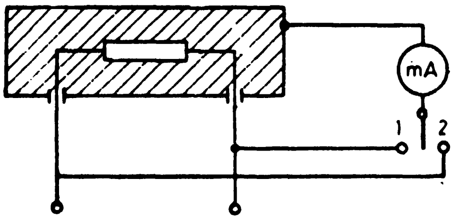


FIG. 3 DIAGRAM FOR LEAKAGE CURRENT MEASUREMENT AT OPERATING TEMPERATURE FOR THREE-PHASE CONNECTION (OTHER THAN CLASS II)

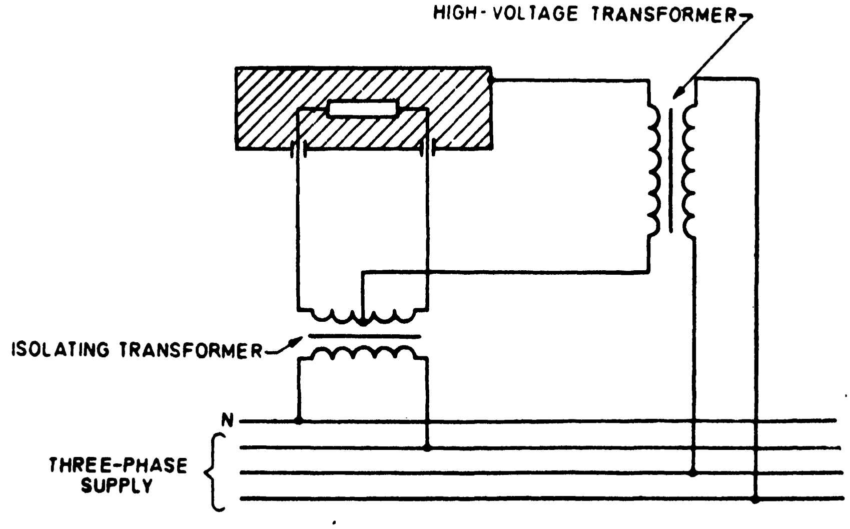


FIG. 4 DIAGRAM FOR ELECTRIC STRENGTH TEST AT OPERATING TEMPERATURE

12.4.4 If the secondary winding of the isolating transformer is not provided with a tap at the mid-point, the output winding of the high-voltage transformer can be connected to the mid-point of a potentiometer having a total resistance not exceeding 2 000 Ω, and connected across the output winding of the isolating transformer.

12.4.5 When applied as a routine test, the high voltage test may also be carried out as a flash test. The appliance may not be connected to the supply and an ac voltage one and a half times shall be applied for a period of 5 seconds (*see* **12.4.2**).

12.4.6 In case electric irons are taken from shelf and subjected to leakage current and high voltage test in isolation, the tests shall be conducted after 10 minutes of preheating.

13 MOISTURE RESISTANCE

13.1 Appliances shall be proof against humid conditions which may occur in normal use.

Compliance is checked by the humidity treatment followed immediately by the high voltage test and leakage current test.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity of not less than 95 percent. The temperature of the air at all places where samples can be located, is maintained at any convenient value between 15°C and 35°C.

Before the electric iron is placed inside the humidity cabinet the sample is brought to a temperature between 15°C and 35°C. The sample is then kept in the cabinet for 48 hours for ordinary appliances.

In most cases, the sample may be brought to the specified temperature by keeping it at this temperature for at least 4 hours before the humidity treatment. A relative humidity of approximately 95 percent can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3), in water, having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

13.2 After this treatment, the electric iron shall show no damage and also withstand high voltage test and leakage current.

The test is made on the cold electric iron not connected to the supply after the humidity treatment in the humidity cabinet or in the room in which one sample is brought to the prescribed temperature. A test voltage is then applied, which is 1·06 times the rated voltage, or the upper limit of the rated voltage range.

13.3 The leakage current measured after the application of the test voltage shall not exceed 600 μA (peak), that is, 420 μA (rms). In general, electric iron may be operated up to 10 minutes before leakage current test measurement.

13.4 Immediately after the leakage current test, the insulation is subjected for one minute to a voltage of substantially sine-wave form having frequency of 50 Hz to 60 Hz. The value of test voltages are given below:

Sl No.	*Points of Application of Test Voltage*	*Test Voltage*, V
1	Between live parts and parts of the body that are separated from live part by:	
	basic insulation only	1 000
	reinforced insulation	3 750
2	Between live parts of different polarity	1 000
3	For parts with double insulation, between metal parts separated from live parts by basic insulation only and	
	live parts	1 000
	the body	2 500
4	Between metal enclosures or covers lined with insulation material and metal foil in contact with the inner surface of the lining, if the distance between live parts and these metal enclosures or covers, measured through the lining, is less than the appropriate clearance as specified in clause 24	1 000
5	Between metal foil in contact with handles, knobs, grips and the like and their shafts, if these shafts can become live in the event of an insulation fault	2 500
6	Between the body and either the power supply cord wrapped with metal foil or a metal rod of the same diameter as the power supply cord, inserted in its place, fitted in inlet bushings of insulating material, cord guards, cord anchorages and the like	1 000

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

14 ENDURANCE

14.1 Electric iron shall be so constructed that, in normal use, there will be no electrical or mechanical failure that might impair compliance with this standard. The insulation shall not be damaged and contacts and connections shall not work loose as a result of heating, vibration, etc.

14.2 The electric iron shall be supported on its stand and shall be operated at 1·15 times the maximum rated input. In case of automatic irons, the thermostat shall be at the maximum setting. For irons without thermostat, or self-resetting thermal cut-outs, the temperature of the sole plate shall be maintained between 205°C and 260°C by suitable cooling means such as a jet of air or a cooling plate. The iron is operated for 200 hours under these conditions.

After this test the electric iron shall withstand high voltage test as given in **12.4**.

15 ABNORMAL OPERATION

15.1 Electric iron shall be so designed that the risk of fire, mechanical damage impairing safety or protection against electric shock as a result of abnormal or careless operation is obviated as far as possible.

15.2 Non-thermostatic iron is checked by the test specified below in (a) and if necessary by the test specified in (b) without adequate heat discharge. The electric iron shall be placed on the floor of the test corner, supported on its stand.

a) Electric irons are tested until steady conditions are established at a supply voltage such that the input is 0·85 times the rated input.

   If a non-self-resetting thermal cut-out operates, or if the current is otherwise interrupted before steady conditions are established, the operating period is considered to be ended and the test specified in (b) is not made.

   If interruption of the current does not occur, the appliance is switched off as soon as steady conditions are established, and is allowed to cool down to approximately room temperature. The appliance is then subjected to the test specified below in (b).

b) The test of (a) is repeated, but with a supply voltage such that the input is 1·24 times the rated input.

NOTE — In case of doubt, a test is made with the most unfavourable supply voltage between the limits specified in (a) and (b).

15.3 The thermostatic electric iron is operated at such a voltage that the input is equal to 1·24 times the maximum rated input. The iron is operated under conditions of adequate heat discharge but with the thermostat short circuited. In case more than one temperature control is provided, these shall be short circuited in turn.

15.4 If, in any of the tests, a non-self-resetting thermal cut-out operates, a heating element ruptures or if the current is otherwise interrupted before steady conditions are established, the heating period is considered to be ended, but if the interruption is due to the rupture of heating element or of an intentionally weak part, the relevant test is repeated on a second sample which shall then also comply with the conditions specified in **15.5** and **15.6**.

NOTES

1 Rupture of a heating element or of an intentionally weak part in the second sample will not in itself entail a rejection.

2 Fuses, thermal cut-outs, overcurrent releases or the like, incorporated into the appliance, may be used to provide the necessary protection.

15.5 During the tests of **15.2** and **15.3** the appliance shall not emit flames or molten metal, or poisonous or ignitable gas in hazardous amounts, enclosures shall not deform to such an extent as will impair compliance with this standard and temperature-rises shall not exceed the values shown in the following table.

Parts	*Temperature-Rise* °C
Walls, ceiling and floor of the test corner	150
Insulation of the supply cable or cord	150

15.6 After the tests, the insulation of appliances other than those of Class III, when cooled down to approximately room temperature, shall withstand an electric strength test, the test voltage being:

1 000 V for basic insulation,

2 750 V for supplementary insulation, and

3 750 V for reinforced insulation.

16 STABILITY AND MECHANICAL HAZARDS

16.1 The electric iron shall be stable. Compliance is checked by the following test:

The electric iron with the stand which is attached or incorporated shall be placed on its stand on a plane inclined at an angle of 10° to the horizontal, the cable or cord resting in the most unfavourable position.

If the iron overturns in one or more positions, it is subjected to the temperature test in the overturned positions.

An iron supplied with a separate stand shall be placed on its stand on a plane inclined at an angle of 15° to the horizontal. Light blows are applied to the stand to overcome static friction between iron and stand. If the iron overturns or slips off the stand in one or more position, it is subjected to the test of temperature-rise in all the positions the iron will take up after overturning or slipping off the stand.

During the test, the temperature-rise shall not exceed the values shown in Table 1.

17 MECHANICAL STRENGTH

17.1 Electric iron shall have adequate mechanical strength and be so constructed as to withstand such rough handling as may be expected in normal use.

Compliance is checked by applying blows to the sample, by means of the spring-operated impact-test apparatus shown in Fig. 5.

The apparatus consists of three main parts, the body, the striking element and the spring-loaded release cone.

The body comprises of the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of this assembly is 1 250 g.

The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 g.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of HR 100, with a radius of 10 mm; it is fixed to the hammer shaft in such a way that the distance from its tip to the plane of the front of the cone, when the striking element is on the point of release, is 20 mm.

The cone has a mass of 60 g and the cone spring is such that it exerts a force of 20 N when the release jaws are on the point of releasing the striking element.

The hammer spring is adjusted so that the product of the compression, in millimetres, and the force exerted, in newtons, equals 1 000, the compression being approximately 20 mm. With this adjustment, the impact energy is 0·5 ± 0·05 Nm.

The release mechanism springs are adjusted so that they exert just sufficient pressure to keep the release jaws in the engaged position.

The apparatus is cocked by pulting the cocking knob until the release jaws engage with the groove in the hammer shaft.

The blows are applied by pushing the release cone against the sample in a direction perpendicular to the surface at the point to be tested.

The pressure is slowly increased so that the cone moves back until it is in contact with the release bars, which then move to operate the release mechanism and allow the hummer to strike.

The sample as a whole is rigidly supported and three blows are applied to every point of the enclosure, that is, likely to be weak.

To ensure that the sample is rigidly supported, it may be necessary to place it against a solid wall of brick, concrete or the like, covered by a sheet of a polyamide which is tightly fixed to the wall, care being taken that there is no appreciable air gap between the sheet and the wall. The sheet must have a Rockwell hardness of HR 100, a thickness of at least 8 mm and a surface area such that no part of the sample is mechanically overstressed due to insufficient supporting area.

If necessary, the blows are also applied to handles, knobs and the like, and to signal lamps and their covers, but only if the lamps or covers protrude from the enclosure by more than 10 mm or if their surface area exceeds 4 cm². Lamps within the appliance, and their covers, are tested only if they are likely to be damaged in normal use.

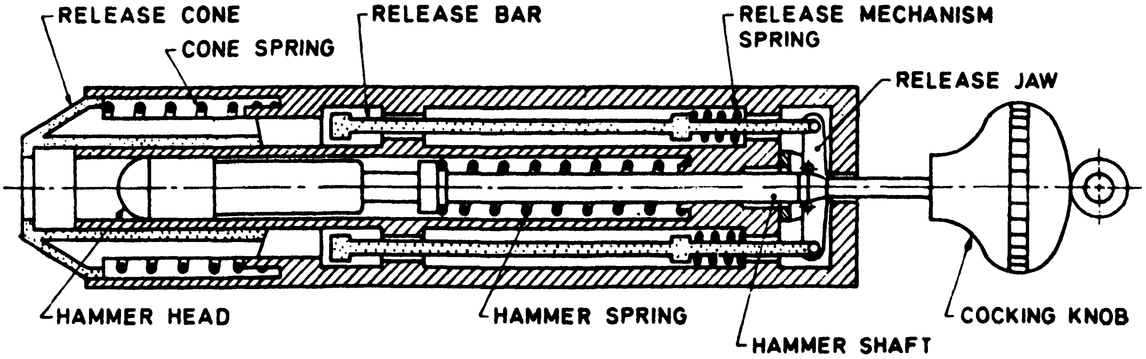


FIG. 5 IMPACT TEST APPARATUS

After the test the sample shall show no damage, in particular live parts shall not have become exposed so as to impair compliance with protection against electric shock, moisture resistance or creepage distances and clearances. In case of doubt, supplementary or reinforced insulation is subjected to high voltage test as given in **12.4**.

Damage to the finish, small dents that do not reduce creepage distances and clearances below the values specified, and small chips which do not adversely affect the protection against electrical shock or moisture are neglected.

Cracks not visible to the naked eye and surface cracks in mouldings and the like are ignored.

If a decorative cover is backed by an inner cover, fracture of the decorative cover is neglected if the inner cover withstands the test after removal of the decorative cover.

17.2 The test may be carried out by alternative method specified below.

17.2.1 The appliance is held against a solid wall of bricks, concrete or the like, and the test apparatus is so arranged that the pivot of the pendulum is vertically above the point of impact of the hammer. The striking element is then allowed to fall from such a height of 250 mm. There blows are applied to every part of the enclosure which is likely to be weak, including handles, levers and the like, but excluding signal lamps and their covers if these do not protrude from the enclosure by more than 3 mm or have a surface not exceeding 3 cm^2. Lamps within an appliance and their covers are tested only if they are likely to be damaged in normal use.

The sample as a whole is rigidly supported and three blows are applied to every point of the enclosure, that is, likely to be weak.

17.2.1.1 A typical impact apparatus is shown in Fig. 6.

17.2.1.2 The striking element has a hemispherical face of radius 10 mm made of hardwood, polyamide or similar material weighing 0·15 kg. It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and thickness 0·5 mm which is pivoted at its upper end in such a way that it swings only in the vertical plane of the axis of the striking element. The axis of the piovt is 1 m above the axis of the striking element. The design of the apparatus is such that a force between 1·0 N and 2·0 N has to be applied to the face of the hammer to maintain the pendulum in a horizontal position.

17.3 In addition to the test specified in **17.1** or **17.2** the compliance is checked by the following test:

The sample is suspended by its handle, with the sole plate in the horizontal position, on

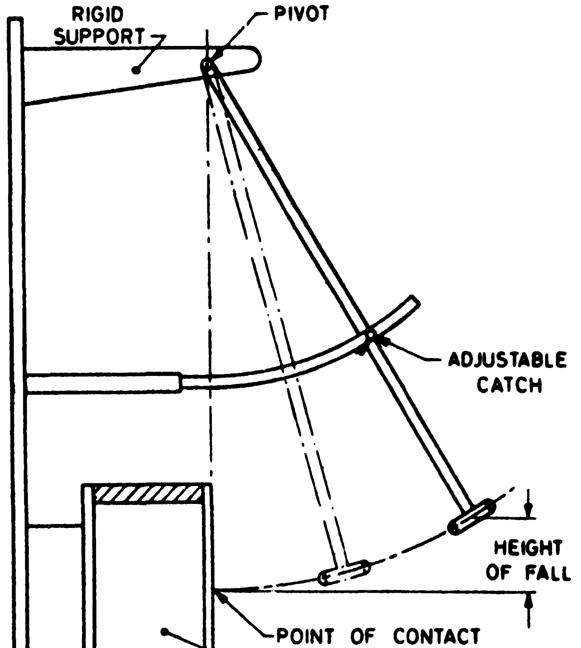


FIG. 6 APPARATUS FOR IMPACT TEST

a machine by which it is dropped 1 000 times, at a rate not exceeding 20 falls per minute, from a height of 40 mm on to a rigidly supported steel plate having a thickness of at least 15 mm and a mass of at least 15 kg (*see* Fig. 7).

The machine is so designed that the iron rests on the steel plate for approximately 15 percent of the duration of the test, and the sample is so mounted that there is no additional weight which would influence the impact energy.

During the test, the iron is operated so that he sole plate temperature is maintained as specified for conditions of adequate heat discharge.

After the test, a thermostatic iron shall not change its calibration by more than +10°C or −20°C. There shall be no exposure of live parts caused by breakage or distortion of the enclosure.

18 CONSTRUCTION

18.1 Electric iron shall be of the appropriate class with respect to protection against electric shock.

Compliance is checked by inspection and by the tests of protection against electric shock.

18.2 Electric iron shall have the appropriate degree of protection against moisture.

Compliance is checked by inspection and by the tests of moisture resistance.

18.3 Electric iron which can be adjusted to suit different voltages shall be so constructed that accidental changing of the setting is unlikely to occur.

18.4 Electric iron shall be so constructed that accidental changing of the setting of thermostats or other control devices is unlikely to occur if this might result in a hazard.

Compliance with the requirements of **18.3** and **18.4** is checked by manual test.

18.5 It shall not be possible to remove parts which ensure the required degree of protection against moisture without the aid of a tool.

Compliance is checked by manual test.

18.6 Handles, knobs and grips shall be fixed in a reliable manner so that they will not work loose in normal use if loosening might result in a hazard.

If handles and knobs are used to indicate the position of switches or similar components, it shall not be possible to fix them in a wrong position if this might result in a hazard.

Compliance is checked by inspection, by manual test and by trying to remove the handle, knob, grip or lever by applying an axial force for 1 minute.

18.7 Components which may require replacement, such as thermostat and knobs, shall be suitably fixed.

Compliance is checked by inspection and, if necessary, by manual test.

18.8 Materials which burn fiercely, such a celluloid, shall not be used in the construction of electric iron.

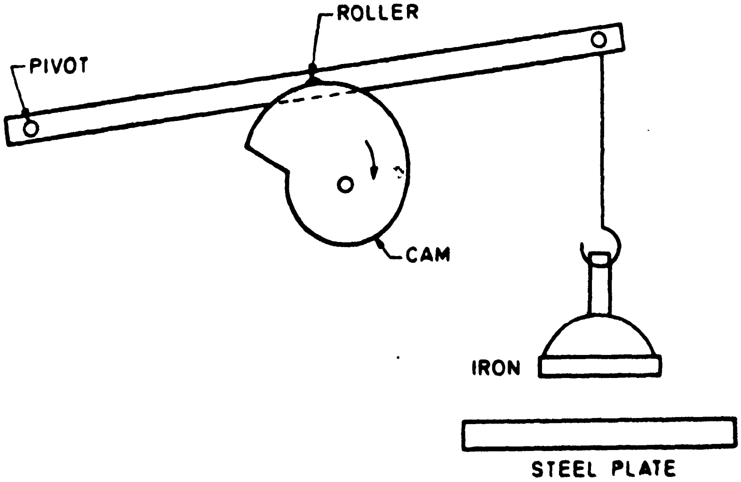


FIG. 7 APPARATUS FOR DROP TEST

18.9 Wood, cotton, silk, ordinary paper, thermocole, wool and similar fibrous or hygroscopic material shall not be used as insulation, unless impregnated and dried.

Asbestos is considered to be fibrous material within the meaning of this standard.

Insulating material is considered to be impregnated if the interstices between the fibres of the material are substantially filled with a suitable insulant.

18.10 Reinforced insulation shall only be used when it is manifestly impracticable to provide separate basic insulation.

Compliance is checked by inspection.

Appliance inlets and switches are examples where reinforced insulation may be used.

18.11 Sleeving may, however, be used as supplementary insulation on internal wiring if it is retained in position by positive means.

Compliance is checked by inspection and by manual test.

Routine servicing includes replacement of power supply cords, switches and the like.

Lining metal enclosures with a coating of lacquer, or with other material in the form of a coating which can be easily removed by scraping, is not considered to meet this requirement.

A sleeve is considered to be fixed by positive means if it can only be removed by breaking or cutting, or if it is clamped at both ends.

18.12 Inside the electric iron, the sheath (jacket) of a flexible cable or cord shall only be used as supplementary insulation where it is not subject to undue mechanical or thermal stresses and if its insulating properties are not less than those specified in IS 9968 (Part 1) : 1981 for the sheaths of flexible cables and cords.

18.13 Handles shall be so constructed that, when gripped as in normal use, contact between the operator's hand and parts having a temperature-rise exceeding the value allowed for handles which, in normal use, are held for short periods only, is unlikely.

Compliance is checked by inspection and if necessary, by determining the temperature-rise.

18.14 Current-carrying parts and other metal parts, the corrosion of which might result in a hazard, shall be resistant to corrosion under normal conditions of use.

Compliance is checked by verifying that after the abnormal test, the relevant parts show no sign of corrosion.

Attention must be paid to the compatibility of the materials of terminals and terminations and to the effect of heating.

Stainless steel and similar corrosion-resistant alloys and plated steel are considered to be satisfactory for the purpose of this requirement.

18.15 Electric irons shall be either provided with a stand which is attached or incorporated or be delivered with a separate stand.

Compliance is checked by inspection.

18.16 Electric irons shall be provided with a thermostat or thermal cut-out in case the sole plate temperature exceeds 260°C.

19 INTERNAL WIRING

19.1 Wireways shall be smooth and free from sharp edges.

19.1.1 Wires shall be protected so that they do not come into contact with burrs; cooling fins, etc, which may cause damage to their insulation.

19.1.2 Holes in metal through which insulated wires pass shall have smooth well-rounded surfaces or be provided with bushings.

19.1.3 Wiring shall be effectively prevented from coming into contact with moving parts.

19.1.4 Internal wiring and electrical connections between different parts of the appliance shall de adequately protected or enclosed.

19.1.5 Compliance with the requirements are checked by inspection.

19.2 Beads and similar ceramic insulators on live wires shall be so fixed or supported that they do not appreciably change their position; they shall not rest on sharp edges or sharp corners. If beads are inside flexible metal conduits, they shall be contained within an insulating sleeve, unless the conduit cannot move in normal use.

Compliance is checked by inspection and by manual test.

19.3 Internal wiring and heating conductors shall be either so rigid and so fixed or so insulated that, in normal use, creepage distances and clearances cannot be reduced below the specified value.

The insulation, if any, shall be such that it cannot be damaged in normal use.

Compliance is checked by inspection, and by manual test.

19.4 Conductors identified by the green colour shall not be connected to terminals other than earthing terminals.

20 COMPONENTS

20.1 Electric irons shall not be fitted with:

a) switches in flexible cables or cords;

b) devices which, in the event of a fault in the appliance, cause the interruption of the supply by applying a short circuit; and

c) thermal cut-outs which can be reset by a soldering operation.

Compliance with the above requirements is checked by inspection.

20.2 The following component parts that are generally used in appliances are covered by Indian Standards given against them:

Component	*Applicable Indian Standard*
a) Cable and cords	IS 9968 (Part 1) : 1988 Elastomer insulated cables : Part 1 For working voltages up to and including 1 100 V (*first revision*)
b) Switches	IS 3854 : 1988 Specification for switches for domestic and similar purposes (*first revision*)
c) Appliance-connectors	IS 3010 (Part 1) : 1965 Specification for appliance-connectors and appliance-inlets (non-reversible three-pin type): Part 1 Appliance-connectors
d) Appliance-inlets	IS 3010 (Part 2) : 1965 Specification for appliance connectors and appliance-inlets (non-reversible three-pin type) : Part 2 Appliance-inlets
e) Three-pin plugs and socket-outlets	IS 1293 : 1988 Specification for plugs and socket-outlets of rated voltage up to and including 250 V and rated current up to and including 16 A (*second revision*)
f) Resistance wires, tapes and strips for heating elements	IS 3725 : 1966 Specification for resistance wires, tapes and strips for heating elements

21 SUPPLY CONNECTIONS AND EXTERNAL FLEXIBLE CABLES AND CORDS

21.1 The electric iron shall be provided with either an appliance inlet or supply cord which shall be not less than 2 m long. It shall not be provided with more than one means of supply.

21.2 Appliance inlet shall:

a) be so located or enclosed that live parts are not accessible during insertion or removal of the connector;

b) be so placed that the connector can be inserted without difficulty; and

c) be so placed that, after insertion of the connector, the appliance is not supported by the connector for any position of normal use on a flat surface.

Power supply cords shall be assembled by Type X, Y or M attachment.

Power supply cords may be provided with a plug.

Compliance is checked by inspection.

21.3 Power supply cords shall not be inferior to ordinary tough rubber sheathed flexible cord.

Polyvinyl chloride insulated flexible cables or cords shall not be used.

For Class I appliances, the power supply cord shall be provided with a green core, which is connected to the internal earthing terminal of the appliance and to the earthing contact of the plug. The colour of the cores intended for live and neutral connection shall be red and black, respectively.

Power supply cords shall not be exposed to sharp points within, or cutting edges of, the surface of the appliance.

Power supply cord shall have a nominal cross-sectional area not less than those shown in the following table:

Rated Current of Appliance A	*Nominal Cross-Sectional Area* mm²
Up to and including 3	0·50
Over 3 up to and including 10	0·75
Over 10 up to and including 13·5	1

Compliance is checked by inspection and by measurements.

21.5 Electric iron shall be provided with a cord guard at the inlet opening for the power supply cord, unless the inlet or bushing is provided with a smoothly rounded bell-mouthed opening having a radius of curvature at least equal to 1·5 times the overall diameter of the cable or cord with the largest cross-sectional area to be connected.

Cord guard shall:

a) be so designed as to protect the cable or cord against excessive bending where it enters into the appliance;

b) be of insulating material;

c) be fixed in a reliable manner;

d) project outside the appliance for a distance beyond the inlet opening of at least five times the overall diameter or, for flat cords, at least five times the major overall dimension, of the cable or cord delivered with the appliance or they shall comply with the flexing test; and

e) be integral with the power supply cord except for type X attachment.

Compliance is checked by inspection, and by the test given in 21.6.

21.6 Test for Cord Guard

The appliance is tested with the cable or cord. which has a length of approximately 10 cm.

The part of the iron comprising the cable entry fitted with the cord guard and the flexible cable or cord for which the iron is designed, is fixed to the oscillating member of an apparatus similar to that shown in Fig. 8.

21.6.1 The sample is so mounted that the axis of oscillation is tangential to the outer surface of the part in which the cord guard is secured, and when the oscillating member is at the middle of its travel, the axis of the cable or cord, where it leaves the cord guard, is vertical.

21.6.2 A load having a mass equal to that of the iron but not less than 2 kg or more than 6 kg is attached to the cable or cord.

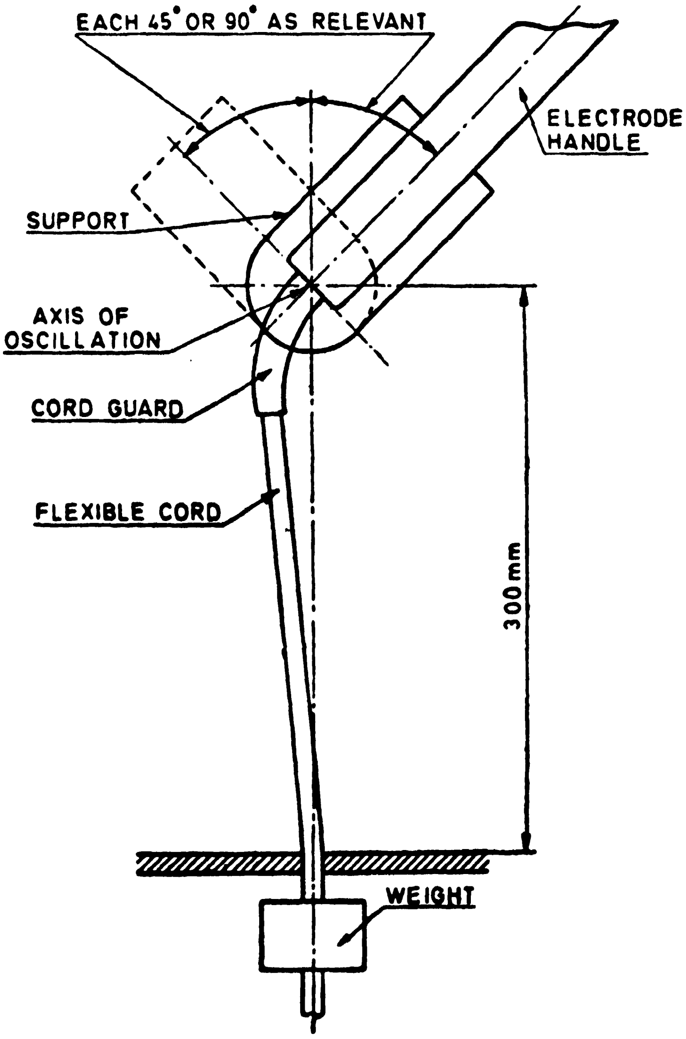


FIG. 8 TEST APPARATUS FOR FLEXIBLE CORDS AND THEIR ANCHORAGES

21.6.3 The oscillating member is moved backwards and forwards through an angle of 90° (45° on either side of the vertical), the number of flexings being 20 000 and the rate of flexing 60/min. After 10 000 flexings, the sample is turned through 90° about the centre line of the cord guard.

21.6.4 After the test, the cord guard shall not have worked loose and neither the cord guard nor the flexible cable or cord shall show any damage within the meaning of this specification except that not more than 10 percent of the total number of conductor strands may have been broken.

NOTE — A flexing is one movement eithe- backward or forward.

21.7 Electric iron provided with a power supply cord shall have cord anchorages such that the conductors are relieved from strain, including twisting where they are connected within the appliance, and that the insulation of the conductors is protected from abrasion.

21.7.1 Cord anchorages shall be so designed or located that:

a) replacement of the cable or cord is easily possible;

b) it is clear how the relief from strain and the prevention of twisting are to be obtained;

c) they are suitable for the different type of cable or cord which may be connected, unless the appliance is so designed that only one type of cable or cord can be fitted;

d) the cable or cord cannot touch the clamping screws of the cord anchorage, if these screws are accessible or electrically connected to accessible metal parts;

e) the cord is not clamped by a metal screw which bears directly on the cord;

f) at least one part of the cord anchorage is securely fixed to the appliance;

g) screws, if any, which have to be operated when replacing the cable or cord, do not serve to fix any other component, unless, when omitted or incorrectly mounted, they render the appliance inoperative or clearly incomplete or unless the parts intended to be fastened by them cannot be removed without the aid of a tool during the replacement of the cable or cord; and

h) for Classs I appliances, they are of insulating material or are provided with an insulating lining, if otherwise an insulation fault on the cable or cord could make accessible metal parts live.

21.7.2 For Type M and Type Y attachments, the cores of the power supply cord shall be insulated from accessible metal parts by insulation complying with the requirements for basic insulation for Class I appliances and complying with the requirements for supplementary insulation for Class II appliances. This insulation shall consist of:

a) a separate insulating barrier fixed to the cord anchorage;

b) a special sleeve or grommet fixed to the cable or cord; or

c) for Class I appliances, the sheath of a sheathed cable or cord.

21.7.3 For Type M and Type Y attachments, cord anchorages shall be so designed that:

a) the replacement of the power supply cord does not impair compliance with this standard;

b) the cable or cord does not touch clamping screws of the cord anchorage, if these screws are accessible or electrically connected to accessible metal parts;

c) the cable or cord is not clamped by a metal screw which bears directly on the cable or cord;

d) knots in the cord are not to be used, unless specifically allowed in individual appliance standard; and

e) labyrinths or similar means are permitted provided that it is clear how the power supply cord is to be assembled.

21.7.4 It shall not be possible to push the cable or cord into the iron to such an extent that the cable or cord, or internal parts of the appliance, could be damaged.

21.7.5 The cable or cord is then subjected 25 times to a pull of the value shown below. The pulls are applied in the most unfavourable direction without jerks, each time for one second.

Immediately afterwards, the cable or cord is subjected for one minute to a torque of the value shown in the following table:

Mass of Appliance kg	*Pull* N	*Torque* Nm
Up to and including 1	30	0·1
Over 1 up to and including 3·5	60	0·25

During the tests, the cable or cord shall not be damaged.

21.7.6 After the tests, the cable or cord shall not have been longitudinally displaced by more than 2 mm and the conductors shall not have moved over a distance of more than 1 mm in the terminals, nor shall there be appreciable strain at the connection.

21.7.7 Creepage distances and clearances shall not be reduced below the specified value.

21.7.8 For the measurement of the longitudinal displacement, a mark is made on the cable or cord while it is subjected to the pull, at a distance of approximately 2 cm from the cord anchorage or other suitable point, before starting the tests.

21.7.9 After the tests, the displacement of the mark on the cable or cord in relation to the cord anchorage or other point is measured while the cable or cord is subjected to the pull.

22 PROVISION FOR EARTHING

22.1 Accessible metal parts of Class I appliances, which may become live in the event of an insulation fault, shall be permanently and reliably connected to an earthing terminal or termination within the appliance, or to the earthing contact of the appliance inlet.

22.1.1 Earthing terminals and earthing contacts shall not be electrically connected to the neutral terminal, if any.

22.1.2 If accessible metal parts are screened from live parts by metal parts which are connected to the earthing terminal or termination or, to the earthing contact, they are not, for the purpose of this requirement, regarded as likely to become live in the event of an insulation fault. Metal parts behind a decorative cover which does not withstand the test of mechanical strength are considered to be accessible metal parts.

22.2 The connection between the earthing terminal or earthing contact and parts required to be connected thereto, shall be of low resistance.

22.2.1 Compliance is checked by the following test:

> A current derived from an ac source having a no-load voltage not exceeding 12 V, and equal to 1·5 times the rated current of the appliance or 25 A, whichever is greater, is passed between the earthing terminal or earthing contact, and each of the accessible metal parts in turn.
>
> The voltage drop between the earthing terminal of the electric iron or the earthing contact of the appliance inlet, and the accssible metal part is meassured, and the resistance calculated from the current and this voltage drop.
>
> In no case shall the resistance exceed 0·1 Ω. The resistance of the flexible cable or cord is not included in the resistance measurement.
>
> Care is taken that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.

23 SCREWS AND CONNECTIONS

23.1 Screwed connections, electrical or otherwise, shall withstand the mechanical stresses occurring in normal use.

23.1.1 Screws transmitting contact pressure and screws which are likely to be tightened by the user and have a nominal diameter less than 3 mm, shall screw into metal.

Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

23.1.2 Screws of insulating material shall have a nominal diameter of at least 3 mm; they shall not be used for any electrical connection.

23.1.3 Screws shall not be of insulating material if their replacement by a metal screw could impair supplementary insulation or reinforced insulation, neither shall screws which may be removed when replacing a power supply cord or undertaking other routine servicing, be of insulating material if their relacement by a metal screw could impair basic insulation.

23.1.4 Compliance is checked by inspection and, for screws and nuts transmitting contact pressure, or which are likely to be tightened by the user, by the following test.

The screws or nuts are tightened and loosened;

> 10 times for screws in engagement with a thread of insulating material, and
>
> 5 times for nuts and other screws.
>
> Screws in engagement with a thread of insulating material are completely removed and reinserted each time.

23.1.5 When testing terminal screws and nuts, a conductor of the cross-sectional area of 0·75 mm^2 is placed in the terminal.

23.1.6 The test is made by means of a suitable test screwdriver, spanner or key applying a torque as shown in the following table, the appropriate column being:

Col I For metal screws without heads, if the screw when tightened does not protrude from the hole.

Col II For other metal screws and for nuts; and

For screws of insulating material:

a) having a hexagonal head with the dimension across flats exceeding the overall thread-diameter; or

b) with a cylindrical head and a socket for a key, the socket having a cross-corner dimension exceeding the overall thread-diameter; or

c) with a head having a slot or cross slots, the length of which exceeds 1·5 times the overall thread-diameter.

Col III For other screws of insulating material.

Nominal Diameter of Screw mm	*Torque*, Nm		
	Col I	Col II	Col III
Up to and including 2·8	0·2	0.4	0·4
Over 2·8 up to and including 3·0	0·25	0·5	0·5
Over 3·0 up to and including 3·2	0·3	0·6	0·6
Over 3·2 up to and including 3·6	0·4	0·8	0·6
Over 3·6 up to and including 4·1	0·7	1·2	0·6
Over 4·1 up to and including 4·7	0·8	1·8	0·9
Over 4·7 up to and including 5·3	0·8	2·0	1·0
Over 5·3 up to and including 6·0	—	2·5	1·25

The conductor is moved each time the screw or nut is loosened.

23.1.6.1 During the test, no damage impairing the further use of screwed connections shall occur.

23.1.6.2 Screws or nuts which are likely to be tightened by the user include screws intended to be operated when replacing the power supply cord.

23.1.6.3 The shape of the blade of the test screwdriver must suit the head of the screw to be tested. The screws and nuts must not be tightened in jerks.

23.2 Screws in engagement with a thread of insulating material shall have a length of engagement sufficient to ensure a reliable connection.

Correct introduction of the screw into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by the test of **23.1**, the torque applied being, however, increased to 1·2 times the torque specified.

The requirement with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

23.3 Screws which make a mechanical connection between different parts shall be secured against loosening, if the connection carries current.

Rivets used for current carrying connections shall be secured against loosening, if these connections are subject to torsion in normal use.

Compliance is checked by inspection and by manual test.

For electric irons provided with an appliance inlet, the measurements are made with an appropriate connector inserted; and also without conductors; for other appliances, they are made on the appliance as delivered.

24 CREEPAGE DISTANCES AND CLEARANCES

24.1 Creepage distances and clearances shall not be less than the values shown in Table 2.

NOTES

1 If a barrier is interposed and if it is in two parts which are not cemented together, the creepage distance is also measured through the joint.

2 If a barrier is interposed, clearances are measured over the barrier or if the barrier is in two parts with mating surfaces which are not cemented together through the joint.

The clearances between terminals and accessible metal parts are also measured with the screws or nuts unscrewed as far as possible, but the clearances shall then be not less than 50 percent of the values shown in the Table 2.

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface the foil is pushed into corners and the like by means of the standard test finger shown in Fig. 1, but it is not pressed into openings.

24.2 The methods of measuring creepage distances and clearances to be used in interpreting the requirements of this report are indicated in Cases 1 to 11. These cases do not differentiate between gaps and grooves or between types of insulation.

Table 2 Creepage Distances and Clearances
(*Clause* 24.1)

All dimensions in millimetres.

Sl No.	**Distances**	**Creepage Distance**	**Clearance**
(1)	(2)	(3)	(4)
i)	Between live parts of different polarity :		
	if protected against deposition of dirt	2·0	2·0
	if not protected against deposition of dirt	3·0	2·5
ii)	Between live parts and other metal parts over basic insulation :		
	if protected against deposition of dirt		
	if of ceramic material or pure mica and the like	2·5	2·5
	if of other material	3·0	2·5*
	if not protected against deposition of dirt	4·0	3·0
	at the end of tubular sheathed-type heating element	1·0†	1·0‡
iii)	Between metal parts separated by supplementary insulations	4·0	4·0
iv)	Between live parts in recessses in the mounting face of the appliance and the surface to which it is fixed	6·0	6·0

*If the parts are rigid and located by mouldings, or if the design is otherwise such that there is no likelihood of a distance being reduced by distortion or movement of the parts, this value may be reduced to 2·0.

†If over ceramic, pure mica and the like protected against deposition of dirt.

‡If protection against deposition of dirt.

The following assumptions are made:

a) Any corner is assumed to be bridged with an insulating link of X-mm width moved into the most unfavourable position (*see* Case 3).

b) Where the distance across the top of a groove is X-mm or more, a creepage distance is measured along the contours of the grooves (*see* Case 2).

c) Creepage distances and clearances measured between parts moving in relation to each other are measured when these parts are in their most unfavourable positions.

In the illustrations

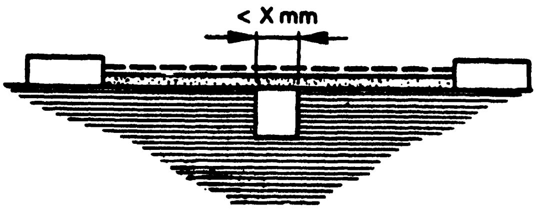
▤ indicates insulating material,

▭ indicates conducting parts,

------- indicates clearance, and

▒ indicates creepage distance.

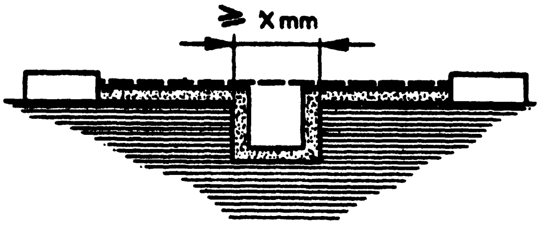
Case 1



Condition — Path under consideration includes a parallel- or converging-sided groove of any depth with a width less than $X = 1$ mm.

Rule — Creepage distance and clearance are measured directly across the groove as shown.

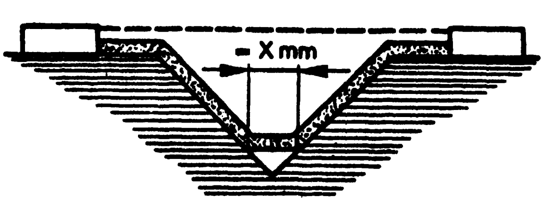
Case 2



Condition — Path under consideration includes a parallel-sided groove of any depth and equal to more than $X = 1$ mm.

Rule — Clearance is the 'line of sight' distance. Creepage path follows the contour of the groove.

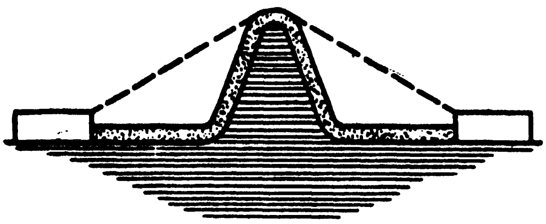
Case 3



Condition — Path under consideration includes a V-shaped groove with a width greater than $X = 1$ mm.

Rule — Clearance is the 'line of sight' distance. Creepage path follows the contour of the groove but 'short-circuits' the bottom of the groove by $X = 1$ mm.

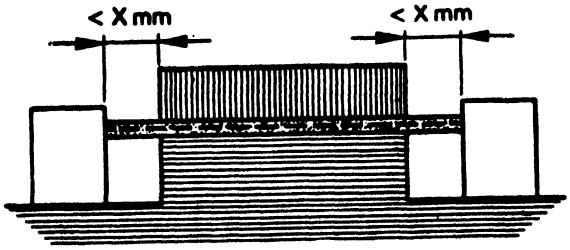
Case 4



Condition — Path under consideration includes a rib.

Rule — Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.

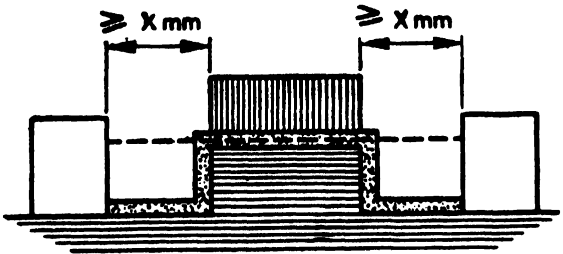
Case 5



Condition — Path under consideration includes an uncemented joint with grooves less than $X = 1$ mm wide on each side.

Rule — Creepage and clearance path is the 'line of sight' distance shown.

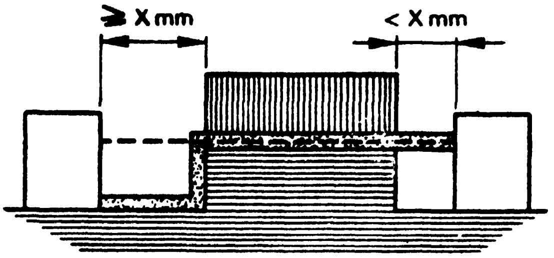
Case 6



Condition — Path under consideration includes an uncemented joint with grooves equal to or more than $X = 1$ mm wide on each side.

Rule — Clearance is the 'line of sight' distance. Creepage path follows the contour of the grooves.

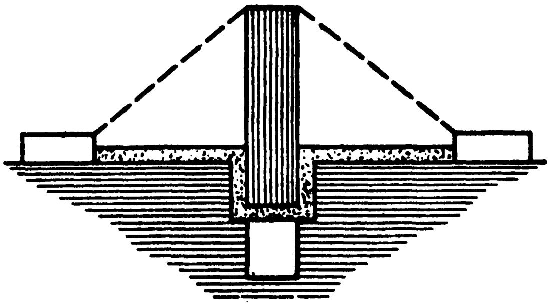
Case 7



Condition — Path under consideration includes an uncemented joint with a groove on one side less than $X = 1$ mm wide and the groove on the other side equal to or more than $X = 1$ mm wide.

Rule — Clearance and creepage paths are as shown.

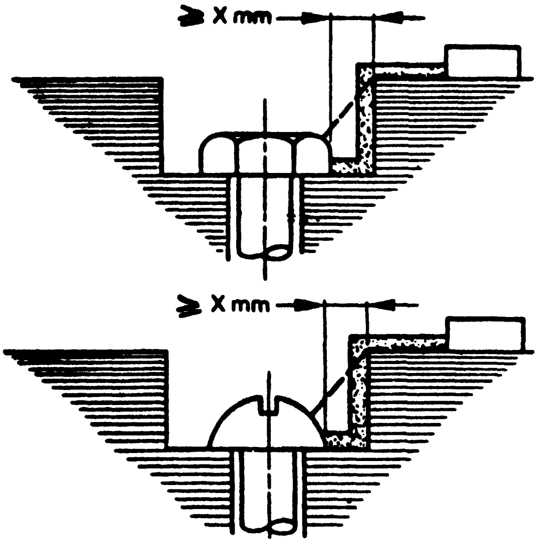
Case 8



Condition — Creepage distance through uncemented joint is less than creepage distance over barrier.

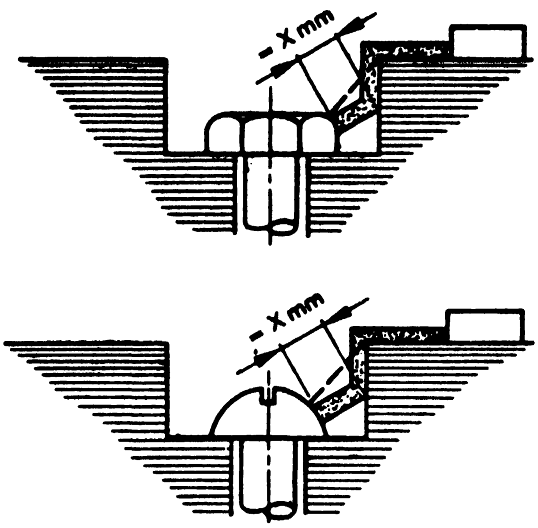
Rule — Clearance is the shortest direct air path over the top of the barrier.

Case 9



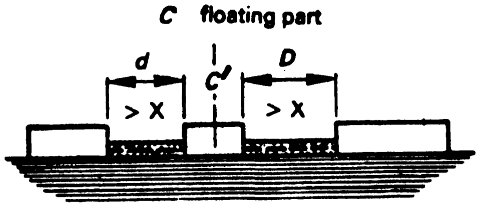
Gap between head of screw and wall of recess wide enough to be taken into account.

Case 10



Gap between head of screw and wall of recess too narrow to be taken into account. Measurement of creepage distance is from screw to wall when the distance is equal to $X = 1$ mm.

Case 11



Clearance is the distance $d + D$.

Creepage distance is also $d + D$.

25 RESISTANCE TO HEAT, FIRE AND TRACKING

25.1 External parts of insulating material, the deterioration of which might cause the appliance to fail to comply with this standard, shall be sufficiently resistant to heat.

25.1.1 Compliance is checked by subjecting enclosures and other external parts of insulating material to a ball-pressure test by means of the apparatus shown in Fig. 9.

25.1.2 The surface of the part to be tested is placed in the the horizontal position and a steel ball of 5 mm diameter is pressed against this surface by a force of 20 N. The test is made in a heating cabinet at a temperature of 75 ± 2°C.

25.1.3 After one hour, the ball is removed from the sample which is thus cooled down within 10 seconds to approximately room temperature by immersion in cold water. The diameter of the impression caused by the ball is measured. This shall not exceed 2 mm.

25.1.4 The test is not made on parts of ceramic material.

25.2 Insulating parts retaining live parts in position shall be resistant to abnornal heat and to fire.

25.2.1 Compliance is checked by the following test:

'A test is made as described in 25.1 but at a temperature of 125 ± 2 °C or at a temperature which is 40 ± 2 °C in excess of the temperature-rise of the relevant part determined during the temperature-rise test whichever is higher.'

25.2.2 In addition, the insulating parts are subjected to a test made with an electrically heated conical mandrel in an apparatus as shown in Fig. 10.

25.2.2.1 The mandrel is inserted into a conical hole reamed in the part to be tested in such a way that portions of the conical part of the mandrel of equal length protrude from both sides. The sample is pressed against the mandrel with a force of 12 N. The means by which the force is applied is then locked to prevent any further movement. However, if the sample starts to soften or to melt during the test, a force just sufficient to keep the sample in contact with the mandrel is applied to the sample in the horizontal direction.

25.2.2.2 The mandrel is heated to a temperature of 300°C in approximately 3 minutes and is maintained within 10°C of this value for 2 minutes. The temperature is measured by means of a thermocouple inside the mandrel.

25.2.2.3 During the period of 5 minutes, sparks of about 6 mm in length are produced at the upper surface of the sample where the mandrel protrudes and the sample is in contact with the mandrel. The sparks are produced by means of a high frequency generator, the electrodes of which are moved around the mandrel so as to cover the whole area of the sample near the mandrel.

25.2.2.4 Neither the sample, nor any gases produced during the heating shall be ignited by the sparks.

25.3 Alternate Method of Test for Fire-Resisting Properties

25.3.1 *Preparation of Sample*

The specimen shall consist of a portion broken from the moulding and shall weigh not less than 6 g nor more than 10 g, and shall be not more than 10·0 mm in thickness measured from an externally cured face.

25.3.2 *Apparatus*

The specimen shall be tested in the heating tube of an apparatus of the general type, shown in Fig. 11, the pilot flame being located 20 mm above the upper end of the specimen.

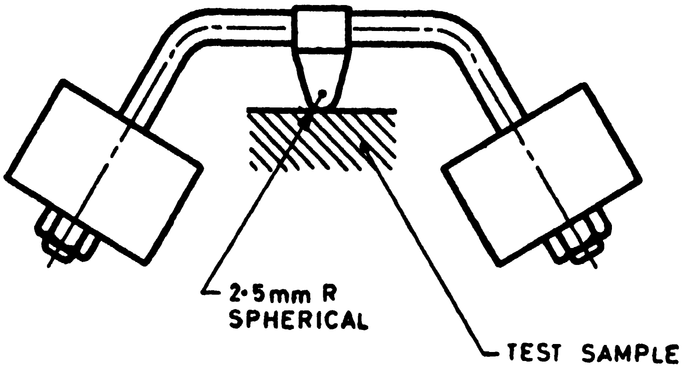


FIG. 9 APPARATUS FOR BALL-PRESSURE TEST

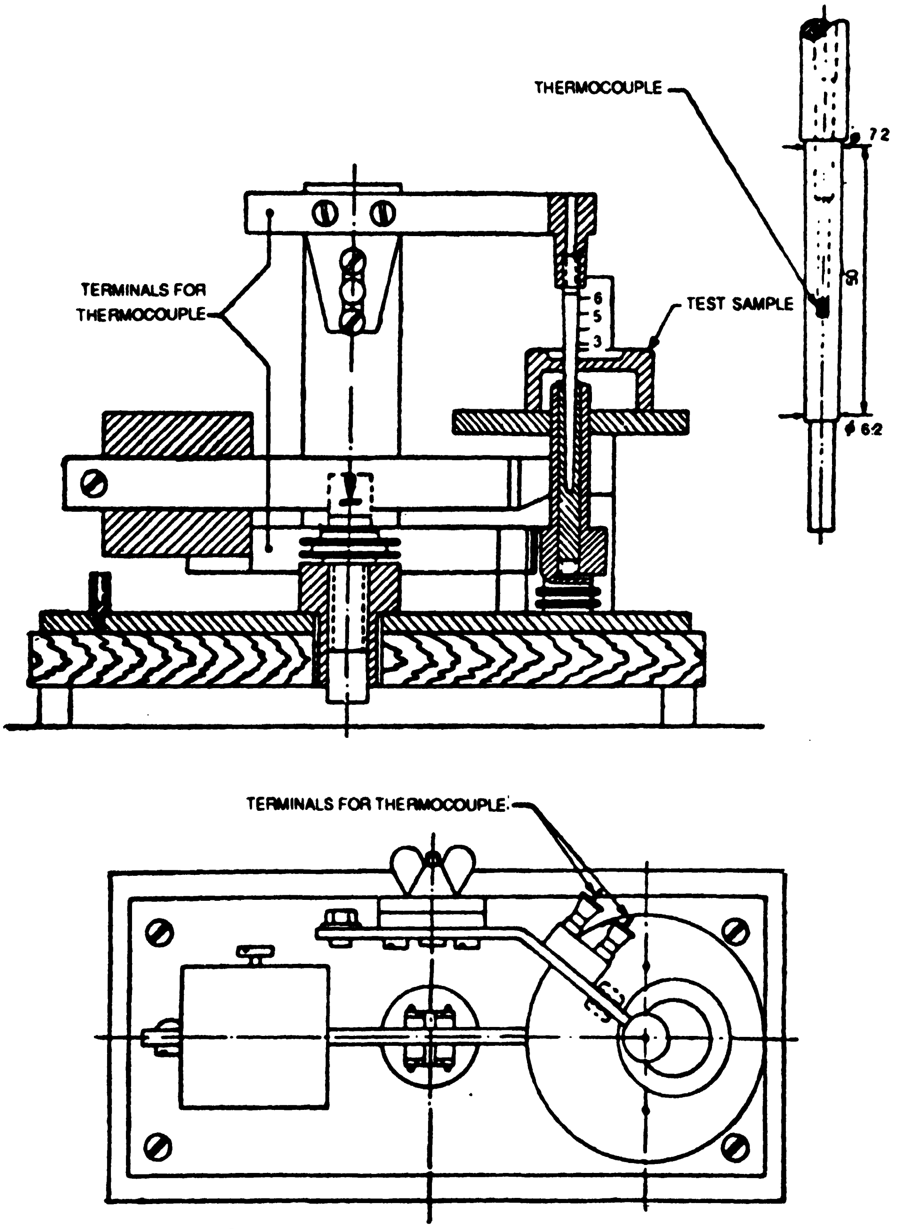
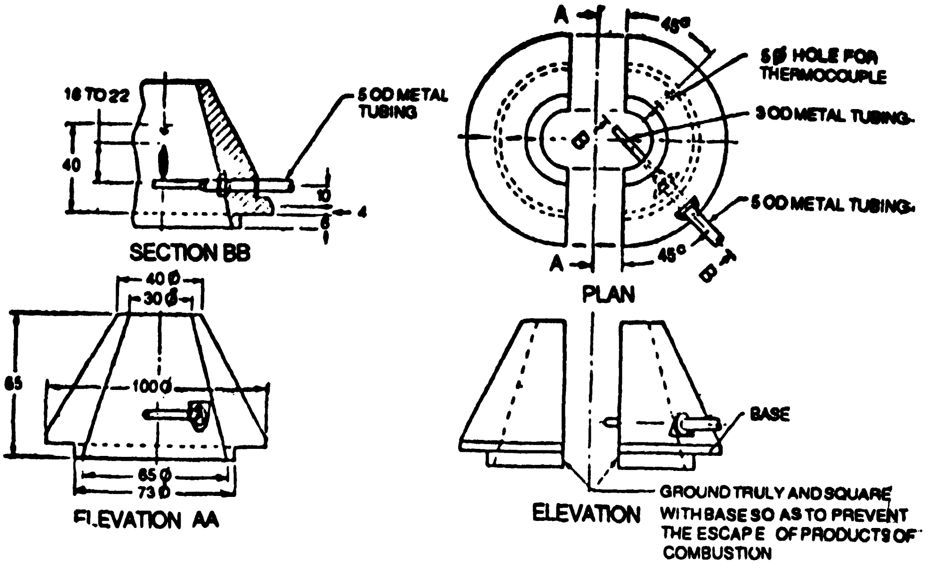
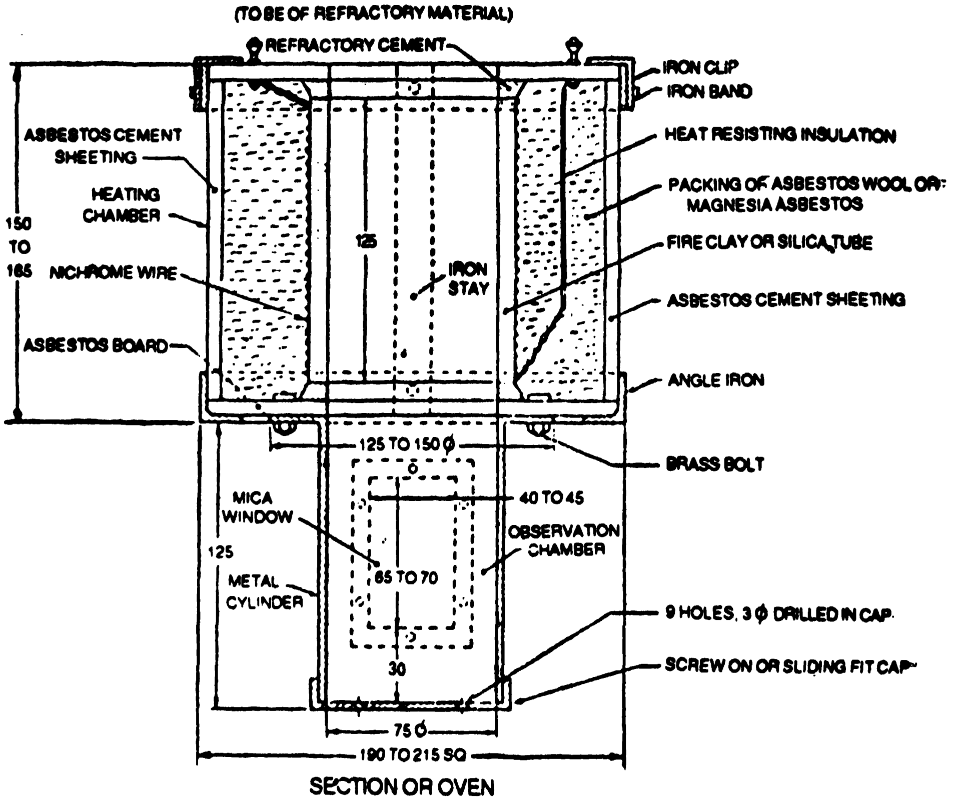


FIG. 10 HOT MANDREL APPARATUS

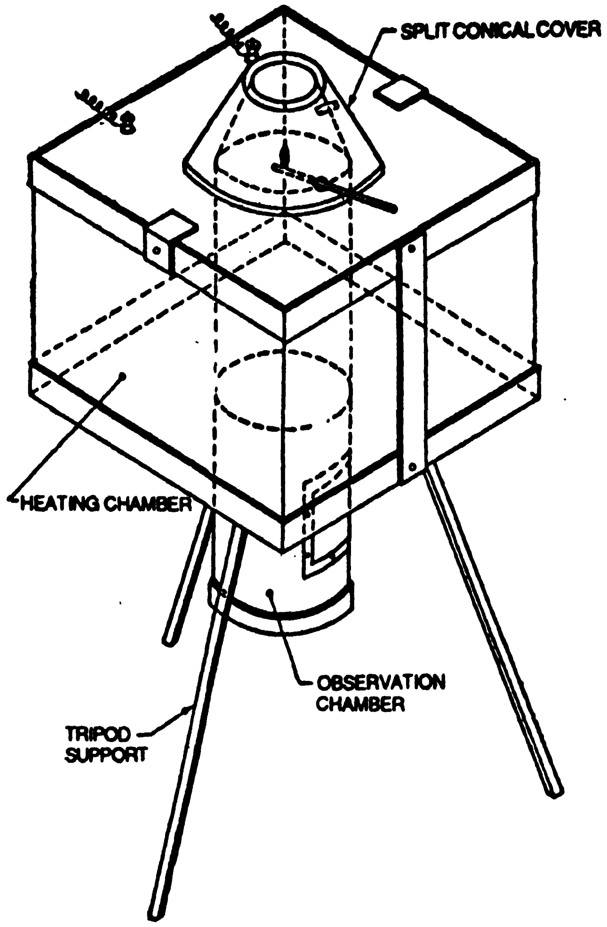


11A Details of Conical Cover



11B Details of Test Oven

FIG. 11 APPARATUS FOR IGNITION TEST — *Continued*



11C Sketch of Assembled Apparatus

FIG. 11 APPARATUS FOR IGNITION TEST

25.3.2.1 A support for the specimen shall be provided in the heating tube and this may suitably consist of a light stirrup of nichrome wire, supported by a length of nichrome wire passing over the pilot flame tube. The support shall be such that the specimen is fixed centrally in the heating tube, with its largest dimension vertical.

The apparatus shall be heated by passing a suitably regulated electric current through a nichrome resistance wire surrounding the heating tube.

25.3.2.2 *Measurement of temperature of tube*

The temperature of the tube shall be taken as shown by a thermocouple situated at the level of the centre of the specimen and equidistant from the inner surface of the heating tube and the specimen. The wires, of which the thermocouple is made, shall be not larger than 1·25 mm and not smaller than 0·462 mm in diameter and shall be bare for a length of 25 mm from the junction.

25.3.3 *Test for Flammability*

The temperature of the tube shall be raised to 300°C and the specimen shall be inserted in the tube. The temperature shall than be readjusted to 300°C within a period of 3 minutes, and this temperature shall be maintained until a period of 5 minutes has elapsed from the time of insertion of the specimen. During this period a conical cover at the top shall limit the opening to approximately 6·5 cm^2 while the air intake orifice at the bottom shall be open approximately 0·65 cm^2. At the end of the period of 5 minutes, the specimen shall be removed from the tube. The material shall not be deemed non-flammable if at any time during the test, the specimen flames or gives off flammable vapours in sufficient quantities to ignite at the pilot flame.

25.4 Insulating parts retaining live parts in position shall be of material resistant to tracking, if they are exposed to excessive deposition of moisture of dirt in normal use, unless the creepage distances are at least equal to twice the specified value.

25.4.1 For materials other than ceramic, compliance is checked by the following test:

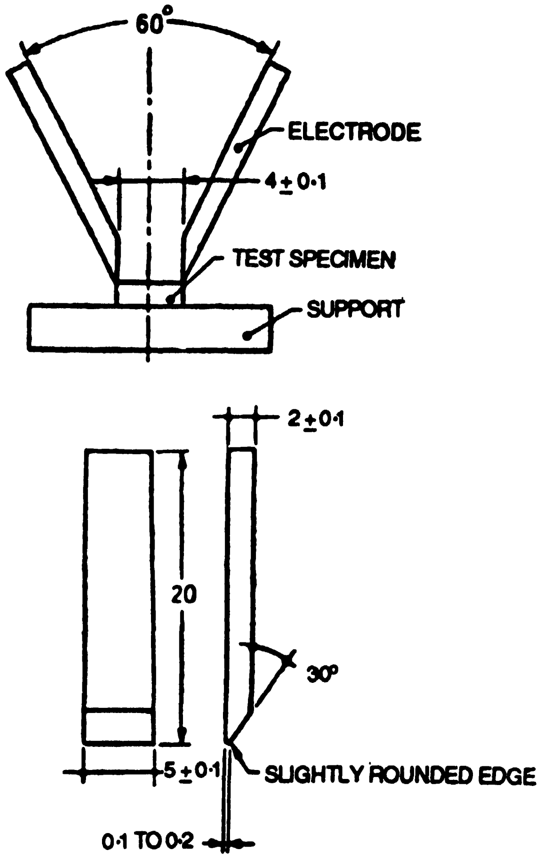
'A flat surface of the part to be tested, if possible, at least 15 mm × 15 mm, is placed in the horizontal position.

Two electrodes of platinum or other sufficiently non-corrodible material, with the dimensions shown in Fig. 12 are placed on the surface of the sample in the manner shown in this figure, so that the rounded edges are in contact with the sample over their whole length.

The force exerted on the surface by each electrode is about 1 N.

The electrodes are connected to a 50 Hz supply such that the no-load voltage is of substantially sine-wave form and has a value of 175 V, which shall not be reduced by more than 17·5 V when the electrodes are short-circuited. The total impedance of the circuit when the electrodes are short-circuited is adjusted by means of a variable resistor, so that the current is equal to 1·0 ± 0·1 A with a power factor between 0·9 and 1. An overcurrent relay is included in the circuit, the relay being so designed that, when the current has reached a value of 0·5 A, the circuit is interrupted after a period which is as short as possible, but not less than 2 seconds.

The surface of the sample is wetted by allowing drops of a solution of ammonium chloride in distilled water to fall centrally between the electrodes. The solution has a volume resistivity of 400 Ω cm at 25°C, corresponding to a concentration of about 0·1 percent. The drops have a volume of $20\,^{+5}_{-0}$ mm^3 and fall from a height of 30 mm to 40 mm.



All dimensions in millimetres.

FIG. 12 ARRANGEMENT AND DIMENSIONS OF THE ELECTRODES FOR THE TRACKING TEST

The time interval between one drop and the next is 30 ± 5 seconds.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen. The test is made at three places on the sample.

NOTES

1 Care be taken that the electrodes are clean and correctly positioned before each test is started.

2 In the case of doubt, the test is repeated, if necessary on a new sample.

3 The test is not made on insulating parts of commutators or brush-caps.

26 RESISTANCE TO RUSTING

26.1 Ferrous parts, the rusting of which might cause the appliance to fail to comply with this standard, shall be adequately protected against rusting.

26.1.1 Compliance is checked by the following test:

> All grease is removed from the parts to be tested by immersion in carbon tetrachloride or trichlorethane for 10 minutes.
>
> The parts are then immersed for 10 minutes in a 10 percent solution of ammonium chloride in water at a temperature between 15°C and 35°C.
>
> Without drying but after shaking off any drops, the parts are placed for 10 minutes in a box containing air having not less than 90 percent relative humidity and temperature between 15°C and 35°C.
>
> After the parts have been dried for 10 minutes in a heating cabinet at a temperature of 100 ± 5°C, their surfaces shall show no signs of rust.
>
> Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.
>
> For small helical spring and the like, and for parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

27 FINISH

27.1 The external finish used on metal components shall be of a heat and moisture resisting nature and shall not be adversely affected by variation in temperature under normal operating conditions. The external finish used on metal components shall be of a heat and moisture resisting nature and shall not be adversely affected by variation in temperature under normal operating conditions or during the endurance test. The nickel and chromium electroplated coating shall conform to the following requirements:

> 10 micrometres (microns) of nickel, and
>
> 0·2 micrometres (microns) of chromium.

27.2 In addition to test for thickness of nickel and chromium plating, the electroplated surface are subjected to the following tests:

a) adhesion test
b) corrosion test

27.3 Adhesion Test

27.3.1 Adhesion of the coating shall be tested by either by the file test or by the quenching method specified in **27.3.3** and **27.3.4**. There shall not be any detachment of the coating from the substrate, or any separation between layers of the coating.

27.3.2 The coating shall be sufficiently adherent to the basis metal and the separate layers of a multilayer coating shall be sufficiently adherent to each other, to pass the test prescribed below.

27.3.3 *File Test for Adhesion*

The file test shall be carried out as follows:

> Saw a piece off a plated article, hold it in a vice and apply a coarse file to the cut edge in such a manner as to raise the deposit. File with direction from the basis metal to the coating at an angle of approximately 45° to the coated surface.
>
> There shall be no separation between the coating and the basis metal nor between the layers of a multiple coating.

27.3.4 *Quenching Test for Adhesion*

Heat a plated article for 1 h in an oven at a temperature of 300°C with a tolerance of ± 10°C. Then quench in water at room temperature. The appearance of blisters or peeling shall give evidence of inadequate adhesion.

CAUTION — This test may have an adverse effect on the mechanical properties of the articles tested.

27.4 Corrosion Resistance Test

27.4.1 Coated articles shall be subjected to one of the corrosion tests appropriate for the service grade number 1.

After the articles have been subjected to the appropriate corrosion test, the rating shall be assigned, to each tested article representing the relative freedom from defects at which the coating is penetrated, with the resulting corrosion of the basis metal. The rating shall be at least 8, for service grade number 1 with test duration of 8 hours for acetic acid salt spray.

27.4.2 Corrosion tests, when carried out in accordance with the tests prescribed in Table 3, are a means of controlling continuity of the coating and the duration of the tests does not necessarily have a fixed relationship with the service life of the finished article.

Table 3 Duration of Corrosion Test

Duration of Hours for Service Grade Number	Acetic-Acid Salt Spray
1	8

27.4.3 *Corrosion Spot*

A surface corrosion defect at which the coating is penetrated as indicated by appearance of basis metal, corrosion products or lifting of the coating. Discoloration or other surface defects, which do not penetrate the coating, do not count as corrosion spots. The size of a corrosion spot is the area of the penetration through the coating and not that of associated staining.

27.4.4 *Examination of Sample After Test*

27.4.4.1 The sample should be examined in its condition at the end of the test or after rinsing in running water, if it is necessary to remove the residue of the test medium. Corrosion products may be removed subsequently, to enable the size of individual corrosion spots to be assessed.

27.4.4.2 For the purpose of evaluation, divide the area of the significant surface of the sample hypothetically into squares of 5 mm size. This is easily done by placing a graticule, made of fully flexible transparent plastics material, on the sample so as to give the most favourable result, that is, the highest rating.

27.4.4.3 Count the number (N) of 5 mm squares in the significant area of the sample and the number (n) of such squares containing one or more corrosion spots. When evaluating the total area of sample, squares more than half occupied should be counted as full squares and those less than half occupied should be ignored.

27.4.4.4 If a spot appears to lie in more than one square, it should be counted only once in the evaluation, but cracks traversing more than one square should be counted for each square entered.

27.4.5 *Suitability of Samples for Evaluation*

27.4.5.1 If ten or more corrosion spots can be included in any two adjacent 5 mm squares, or any spots are present of area greater than 2·5 mm^2, the sample shall be considered unsuitable for assessment. For long cracks traversing more than one 5-mm square, the sample shall be considered unsuitable for assessment if the area of the crack in any one square exceeds 2·5 mm^2.

27.4.5.2 If the sample consists of more than one individual article, and gross differences in the degree of corrosion are evident between these individual articles, the sample shall be considered unsuitable for assessment.

27.4.6 *Initial Rating Number*

Determine the frequency of the spots as a percentage from the expression:

$$\text{Frequency} = 100 \times \frac{n}{N} \quad (\textit{see } 27.4.4.3)$$

Allocate a rating number to the sample according to the following table:

Frequency, Percent	*Rating Number*
0 (No corrosion spots)	10
Over 0 up to 0·25	9
Over 0·25 ,, ,, 0·5	8
Over 0·5 ,, ,, 1	7
Over 1 ,, ,, 3	6
Over 2 ,, ,, 4	5
Over 4 ,, ,, 8	4
Over 8 ,, ,, 16	3
Over 16 ,, ,, 32	2
Over 32 ,, ,, 64	1
Over 64	0

27.5 Determination of Chromium Thickness by Coulometric Method

27.5.1 *Principle*

The method is based on the measurement of the quantity of electricity required to dissolve anodically an electrodeposited coating over a known area.

27.5.2 *Test Solution*

Dilute 62 ml of orthophosphoric acid (sp gr 1·75) to one litre.

27.5.3 *Procedure*

27.5.3.1 Clean the area to be tested with a cloth, wetted with an organic solvent for grease removal, if necessary.

27.5.3.2 Press an electrolytic cell, fitted with a flexible sealing ring and incorporating an annular cathode on to the coating so that a circle of known area is exposed to the test solution. Introduce the test solution into the cell; insert and operate the stirrer if appropriate to the instrument used and the thickness of the deposit.

27.5.3.3 Make the electrical connections with the specimen being anodic. Continue electolysis until dissolution of the chromium coating is complete, as indicated by sudden change in anode potential, and record the quantity of electricity consumed.

27.5.3.4 Examine the specimen and ensure that chromium removal is complete over the area of the cell.

27.5.4. *Calculation*

Calculate the thickness of the chromium coating from the following formula assuming 100 percent current efficiency:

$$\text{Thickness, } \mu\text{m} = \frac{Q}{A} \times 12{\cdot}6$$

where

Q is quantity of electricity consumed, in coulombs; and

A is the area tested, in mm².

27.6 Alternative Method for Determination of Chromium Thickness

27.6.1 *Reagent*

Chromium Stripping Solution

Dissolve 20 g of antimony trioxide (Sb_2O_3) in one litre of concentrated hydrochloric acid of sp gr 1·16.

27.6.2 *Preparation of Surface for Testing*

Rub the test piece with a mild abrasive. Degrease it by rubbing with a damp cloth sprinkled over with fine pumice powder, magnesium oxide or acetone. Dry it in air.

27.6.3 *Method of Testing*

27.6.3.1 Immerse the degreased specimen or the surface to be tested in chromium stripping solution. In case of bulky articles, the test may be localized by using a glass ring about 25 mm in diameter and 25 mm in height clamped in close contact with ther est piece and the joint made good by pressing plasticine around the outside lower periphery of the ring.

27.6.3.2 To stop action on some parts of an article, the attack may be localized to a selected area by coating the remaining surface with nitrocellulose varnish.

27.6.3.3 Record the time, from the appearance of black film over the surface under test to the cessation of gassing, by means of a stop watch. Note down the temperature of the solution.

27.6.3.4 The thickness of deposit is obtained by simple proportion from the time required to dissolve a unit thickness at the temperature of testing (*see* Fig. 13).

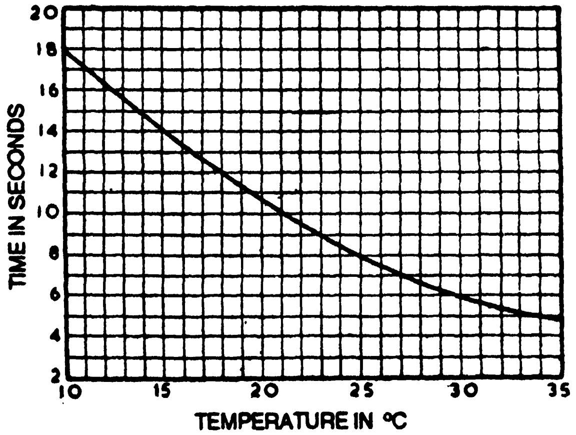


FIG. 13 TIME REQUIRED TO DISSOLVE 0·000 3 mm CHROMIUM AT DIFFERENT TEMPERATURES

27.7 BNF Jet Test for Determination of Thickness of Nickel Plating

27.7.1 *Principle of Method*

Allow a jet of corroding solution to impinge on a small area of the surface to be tested, and measure the time required to penetrate the plating layer. This time is a function of the thickness of the plating layer and of the temperature. The thickness may then be obtained from a suitably calibrated curve in which the time is plotted against the temperature for a given thickness.

27.7.2 *Apparatus*

27.7.2.1 The apparatus (*see* Fig. 14) shall have the following features:

a) *Constant head device* (*A*) — with a thermometer to indicate the temperature of the reagent solution.
b) *On-off stop-cock* (*B*).
c) *Jet* (*C*) — enclosed in glass guard tube and connected to the funnel by rubber tubing.
d) *Sliding clamp* (*D*)
e) *Clamp for test specimen* (*E*)
f) *Dish to receive used solution* (*F*)
g) *Base with levelling screws* (*G*)
h) *A stop-watch* — with 'Stop' and 'Go' arrangement to measure the time of penetration.

27.7.2.2 The solution shall be delivered in jet form under a constant head of 254 mm through a nozzle, that is, a glass capillary tube of 1·5 mm bore and 102 mm minimum length drawn out into a smooth taper.

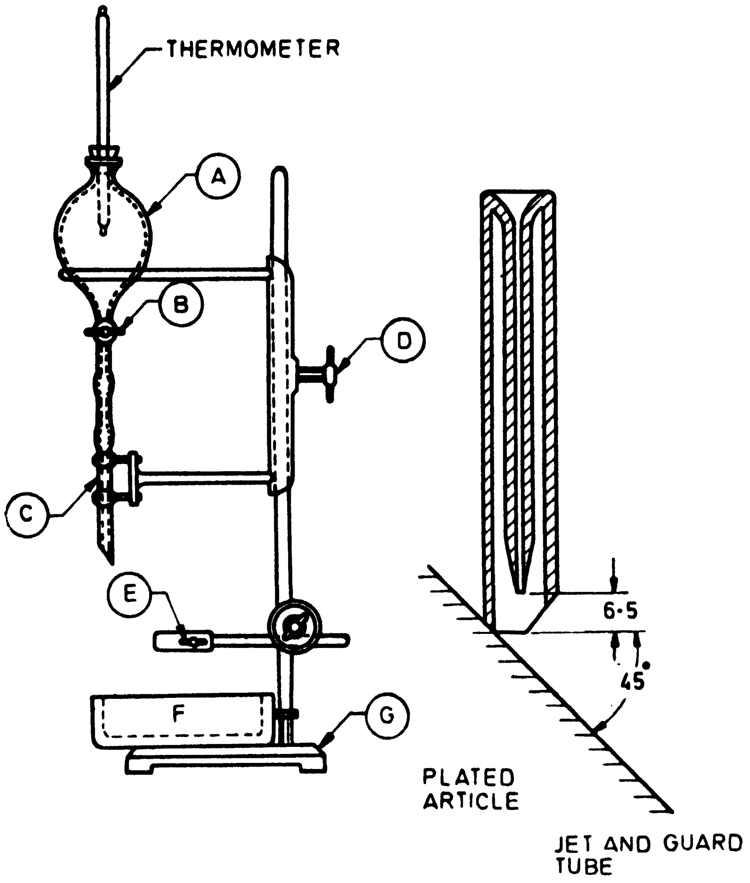


FIG. 14 APPARATUS FOR BNF JET TEST

27.7.2.3 To have a correct velocity of flow, the dimensions of the tapered portion shall be such that:

$\frac{D - d}{L}$ shall lie between 0·030 and 0·045

where

D = internal diameter of capillary tube,

d = internal diameter of the tip of nozzle, and

L = length of taper.

27.7.2.4 The jet delivers 10 ml of water at 20°C in 27 to 29 seconds under a head of 254 mm.

27.7.3 *Reagents*

27.7.3.1 *Test solution*

Dissolve 300 g of ferric chloride ($FeCl_3$, $6H_2O$) and 100 g of copper sulphate ($CuSO_4$, $5H_2O$) in one litre of distilled water.

27.7.3.2 *Concentrated hydrochloric acid* sp gr 1·16

27.7.4 *Preparation of Surface for Testing*

27.7.4.1 Degrease the test piece by rubbing with a damp cloth on which light magnesium oxide has deen sprinkled. Rinse with acetone and dry it in air. Do not use any abrasive.

27.7.4.2 In case of testing nickel deposit, dip the article in a mixture of equal volumes of concentrated hydrochloric acid (sp gr 1·16) and water, to remove the slightly protective film on the surface of nickel.

27.7.5 *Method of Testing*

27.7.5.1 Clamp the degreased specimen so that the surface under test makes an angle of about 45 degrees to the horizontal, and keep it about 6·5 mm below the tip of the nozzle (*see* Fig. 14). Clamp the specimen in such a way that there is no relative movement between the jet and the test piece and there is free run of the solution into the dish placed below. The liquid flowing over specimen should present a smooth unbroken wide surface free of ripples and turbulences.

27.7.5.2 Open the stop-cock and also start the stop-watch at exactly the same moment. Stop both after 5 seconds and inspect sample for penetration. Repeat the process until the first sign of penetration is seen.

27.7.5.3 Total time taken divided by the time required to penetrate 0·002 5 mm of deposits at the particular temperature of testing (obtained from Fig. 15) gives thickness of deposited coatings.

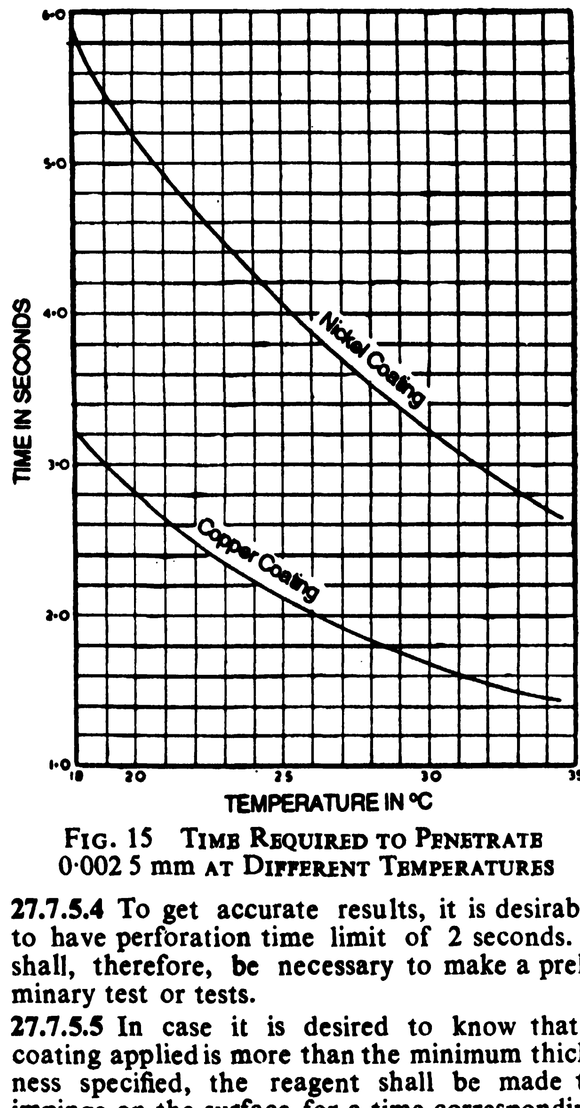


FIG. 15 TIME REQUIRED TO PENETRATE 0·002 5 mm AT DIFFERENT TEMPERATURES

27.7.5.4 To get accurate results, it is desirable to have perforation time limit of 2 seconds. It shall, therefore, be necessary to make a preliminary test or tests.

27.7.5.5 In case it is desired to know that a coating applied is more than the minimum thickness specified, the reagent shall be made to impinge on the surface for a time corresponding to the specified minimum thickness and examined for penetration spot.

27.7.5.6 It is recommended that the test in case of any particular deposit of metal should be standardized against deposits of known thickness made from solution in question.

27.7.6 *Indications*

27.7.6.1 *Indications in case of penetration of copper coatings*

Penetration of the copper coatings shall be indicated by the following signs:

Basic Metal	*Mark*
a) Aluminium and zinc base alloys	Black spot
b) Nickel	White spot
c) Steel	Copper spot (*see* Note)

NOTE — This spot is not readily detectable as it is of the same colour as the surrounding surface. To help distinguish, put 2 drops of either of the following solutions:

a) One gram of antimony oxide added to 100 ml of concentrated hydrochloric acid of sp gr 1·16,

b) Chromium stripping solution diluted with equal volume of water.

27.7.6.2 *Indications in case of penatration of nickel coatings*

Penetration of nickel coatings shall be indicated by the following signs:

Basic Metal	*Mark*
Steel	Copper spot (*see* Note)
Copper	Copper spot which shows up at once
Brass	Brownish yellow spot
Aluminium	Central black spot with a halo of copper
Zinc base alloys	Black spot similar to that of aluminium

NOTE — This copper spot is not formed until the flow is stopped for a few seconds. Owing to the solubility of metallic copper in the excess of the solution a luminary copper coloured blush may form due to pores, but a definite central perforation point should be obtained.

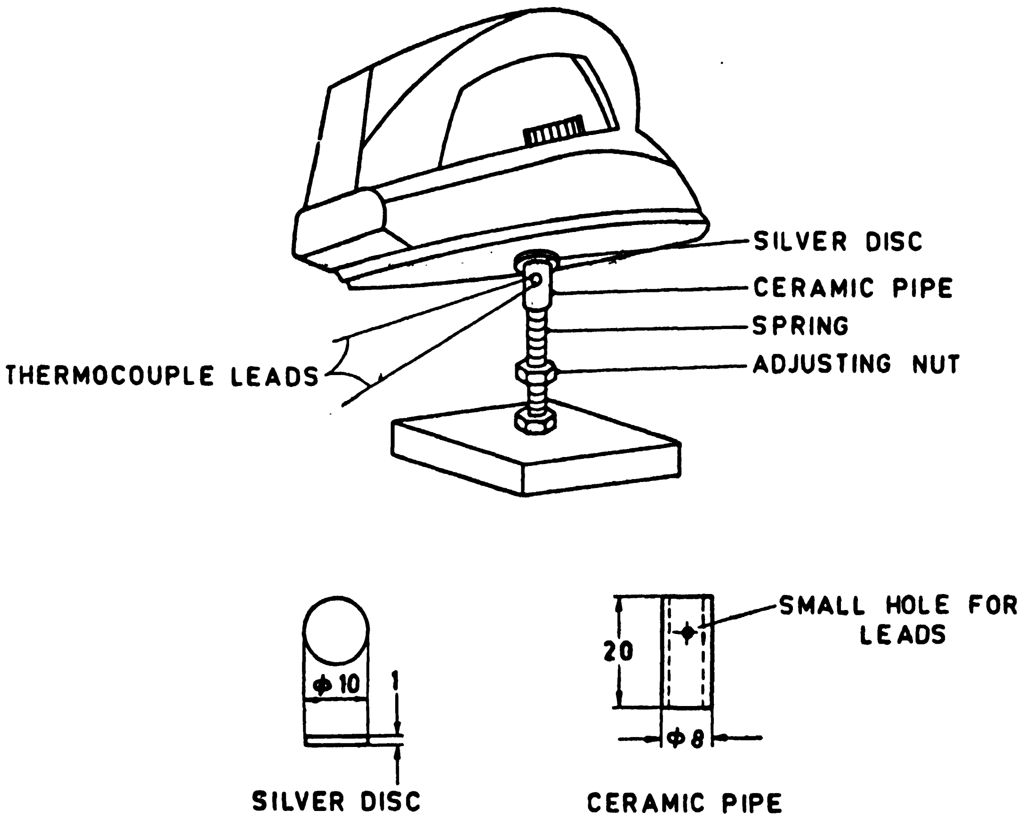
27.7.6.3 *Indications in case of penetration of bright nickel coatings*

The usual end points given by the coating sometimes show a darkening of the test spot by non-adherent blackish matter, which may need to be wiped off at intervals with a stub of paper.

For bright nickel deposited from baths containing sulphonic acid and other organic additives, multiply thickness, obtained by jet test by a correction factor 1·5.

28 MEASUREMENT OF HEATING-UP TIME

28.1 The iron is placed on the three-pointed metallic supports while under measurement. The three-pointed supports are constructed so that they support the sole plate of the iron horizontally at least 100 mm above the base surface on which the iron is placed. The thermocouple is attached at the mid-point of the sole plate (*see* Fig. 16).



NOTE — A thermocouple is soldered at the centre of the silver disc. The silver disc is fixed to the end of the ceramic pipe with heat-resistant adhesive.

FIG. 16 2-WAY OF ATTACHING THERMOCOUPLES

28.2 Starting from ambient temperature, the iron is heated-up with the voltage corresponding to rated input, the thermostat, if any, set at the highest temperature. Where a rated voltage range is specified, this voltage shall correspond to the voltage corresponding to mean rated input.

28.3 The heating-up time which is the time necessary for the temperature to exceed the ambient temperature by 180°C is measured, and is expressed in minutes and seconds. The heating up time shall not exceed 8 minutes.

29 MEASUREMENT OF SOLE PLATE TEMPERATURE

29.1 The iron is placed on the three metallic supports and the thermocouple is attached at the mid-point of the sole plate (*see* Fig. 16). The iron is switched on and heated with a voltage corresponding to rated input.

29.2 For thermostatic iron the highest and the lowest temperatures are measured during five successive cycles of temperature variation after the iron has reached the steady state conditions. The mean value of the five highest and lowest temperature is the sole plate temperature for the setting. This test is repeated for each setting of the thermostat. The recomended ironing temperature ranges for different textiles are given in Table 4.

Table 4 Recommended Ironing Temperature Ranges

Fabric	*Temperature* (°C)
Nylon	70 to 90
Rayon	100 " 120
Silk	130 " 150
Wool	160 " 180
Cotton/Linen	190 " 210

29.3 For irons with self-resetting thermal cut-out, the measurement are carried out in the same way as for thermostatic type.

29.4 For other types of irons, the highest sole plate temperature shall be measured after the iron has reached steady state conditions.

NOTES

1 The steady state temperature is considered to be achieved if the temperature at the mid-point of the sole plate does not vary by more than 1°C per hour.

2 For those irons whose thermostat settings are indicated by a sector the settings shall be at the centre of the range.

3 The adjustment of the thermostat control to obtain the required setting shall be made in the direction of increasing temperature.

30 MEASUREMENT OF TEMPERATURE DISTRIBUTION

30.1 The iron is placed on the three metallic supports and is heated up with the voltage at the corresponding rated input until the sole plate temperature at the mid-point exceeds 200° C. Then after switching off the supply, the iron is placed for a suitable period on a sheet of white paper spread over flannel cloth which covers a wooden board. After removal of the iron, darkening of the paper indicates the temperature distribution over the sole plate. The hottest point is determined as the centre of the darkest area.

NOTE — Positive phototype paper, which is unexposed and developed, white tracing paper, or white blotting paper is recommended as the white paper for this measurement.

30.2 After this the iron is placed on the three metallic supports and a thermocouple is attached at each of the following four points of the sole plate:

a) The hottest point,
b) The mid-point of the sole plate,
c) The point on the longitudinal centre line 20 mm from the tip of the sole plate, and
d) The point on the longitudinal centre line 20 mm from the heal and of the sole plate.

30.2.1 For a thermostatic iron, the thermostat is set so that the temperature at the mid-point is maintained at approximately 150°C under the steady-state conditions, and the measurement is performed after the iron has reached the steady-state conditions.

30.2.2 For other types of iron, the temperature at the mid-point is maintained at approximately 150°C for at least 15 minutes by switching the supply on and off before taking temperature measurements.

30.3 The varying temperature is recorded for 10 minutes and the average temperature for the 10 minutes is determined for each of the four points. The mean of the four average temperatures is then determined, and the difference between each average temperature and the mean temperature is also calculated. The four temperature differences are recorded as the indication of the temperature distribution over the sole plate.

30.4 Any of the four temperature differences recorded in the above test shall not differ by more than 10°C.

31 MEASUREMENT OF INITIAL OVERSWING TEMPERATURE AND HEATING-UP EXCESS TEMPERATURE

31.1 The iron is placed on the three metallic supports and a thermocouple is attached at the hottest point. The iron is then switched on and the thermostat is adjusted so that an average temperature of about 120°C is maintained at the measuring point under the steady-state conditions. The iron is allowed to cool down to room temperature. The iron is switched on again and, using a recording-type instrument, the time and temperature are measured at the hottest point for switching on over nine successive cycles to produce a graph of the type shown in Fig. 17.

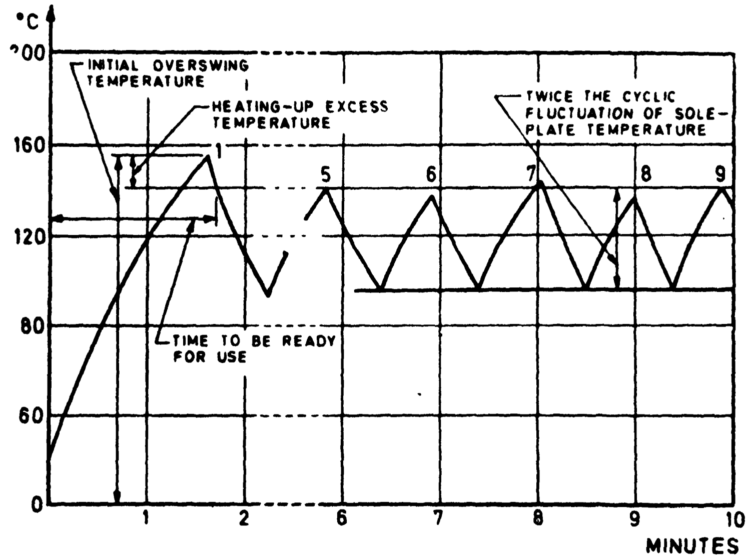


FIG. 17 VARIATION OF SOLE-PLATE TEMPERATURE AFTER SWITCHING ON

31.2 From the graph the following are determined:

a) The initial overswing temperature, which is the first peak temperature between the first and second cut-outs of the thermostat;

b) The mean peak temperature, which is the mean value of the last five peak temperatures; and

c) The heating up excess temperature, which is the difference between the initial overswing temperature and the mean peak temperature.

31.3 The initial overswing temperature shall not be more than 165°C and the heating-up excess temperature shall not exceed 30°C.

32 MEASUREMENT OF CYCLE FLUCTUATION OF TEMPERATURE OF THE HOT-TEST POINT

32.1 The procedure for the temperature measurement is the same as in **31**, except that highest and lowest temperatures of each cycle are measured for five successive cycles after the iron has reached the steady-state conditions. The mean value for the highest temperatures and that for the lowest temperatures are determined. One half of the difference between the mean values is the cyclic fluctuation of the temperature of the hottest point and is expressed in Celsius degrees.

NOTE — This measurement may be combined with the measurements in **31**.

32.2 The cyclic fluctuation of the temperature of the hottest point shall not exceed 12·5°C.

33 MEASUREMENT OF TEMPERATURE DROP UNDER LOAD.

33.1 Measurement of Temperature and Average Input Power Under Idling Operation

The iron is placed on the three metallic supports and a thermocouple is attached at the mid-point of the sole plate. The iron is then switched on and the thermostat is adjusted so that an average temperature of 200 ± 10°C is maintained under the steady-state conditions.

After the iron has reached the steady-state conditions, the highest and the lowest temperatures for five successive cycles are measured, and the mean temperature T_1 for them is determined. At the same time, the average power W_1 of the input consumed under the steady-state conditions is determined by dividing the electric energy in watthours consumed in the course of at least five regulating cycles by the total duration of these cycles.

33.2 Measurement of Temperature and Average Input Power Under Load

The iron is placed on the supports of the measuring apparatus illustrated in Fig. 18 and switched on with the same thermostat as for **33.1**.

The flow rate of cooling water is adjusted so that the temperature difference between outgoing water and incoming water does not exceed 10°C after steady condition is reached.

The height of the pointed supports is determined in a preliminary test in such a way that the average input power absorbed by the iron is about 50 percent of the rated input.

After ten successive cycles of operation of the thermostat, it is assumed that steady condition is reached. The average power W_0 of the input and the mean temperature T_0 of the sole plate under load are determined, as for the idling case in **33.1**.

33.3 For irons with self-resetting thermal cut-out, the measurements at **33.1** and **33.2** shall be carried out in the same way as that of a thermostatic type. For other types of irons, the above measurements are carried out similarly after the iron has reached the steady-state conditions.

33.4 Calculation of Temperature Drop Under Load

The measured temperature drop under load is the difference $T_1 = T_1 - T_0$, T_1 and T_1 being respectively the mean temperature under idling and load determined in **33.1** to **33.3**.

The temperature drop per 100 W load is calculated by the formula:

$$T\,100 = \frac{T \times 100}{W_c - W_1}$$

where

W_c = the average input power under load, and

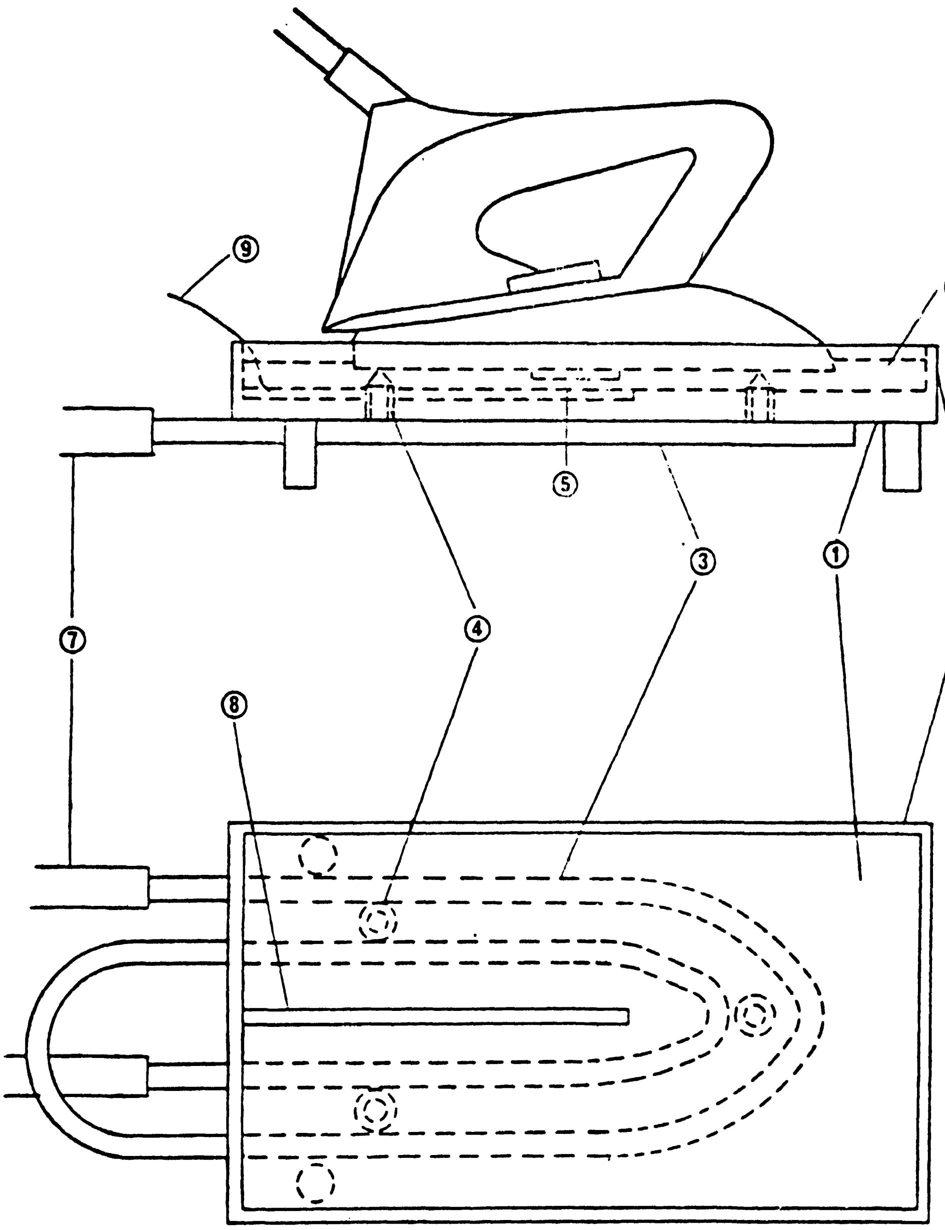
W_1 = the average input power under idling.

33.5 The temperature drop under load shall not exceed 10°C.

34 TESTS

34.1 Categories of Tests

Tests are classified as type, acceptance and routine.



1. Copper base plate
2. Edge of the base plate
3. Cooling pipes
4. Pointed supports
5. Silver disc with a thermocouple
6. Silicone oil
7. Cooling water pipes
8. Slot in the base plate for thermocouple leads
9. Thermocouple leads

NOTE — The base plate (1) is made of copper plate 10 mm to 15 mm thick. Around the periphery of the base plate, the edge (2) about 10 mm high is soldered, so that the plate forms a shallow vessel for silicon oil. Cooling pipes of copper (3) are soldered to the lower surface of the base plate, and are connected to cooling water pipes (7). Three pointed supports (4) are provided on the base plate. The height of the supports can be adjusted from 1 mm to 2 mm. The silver disc with a thermocouple (5) is placed at the mid-point of the soleplate, and it must not touch the base plate. The base plate of the apparatus is held horizontally and is filled with silicone oil 3 mm to 4 mm deep.

FIG. 18 APPARATUS FOR MEASURING TEMPERATURE DROP UNDER LOAD

34.2 Type Tests

The following tests shall constitute the type tests and shall be carried out on two samples of irons of the same type and rating selected preferably at random from a regular production lot. Before commencement of the tests, the irons shall be visually examined and inspected for obvious visual defects in respect of components, parts and their assembly, construction, mechanical hazards, markings, provision of suitable terminals for supply connections, earthing and the effectiveness of screws and connections. The external surface finish shall be even and free from finishing defects.

a) Protection against electric shock,

b) Input,

c) Temperature-rise,

d) Operation under overload conditions,

e) Electrical insulation and leakage current at operating temperature,

f) Moisture resistance,

g) Insulation resistance and electric strength (after humidity treatment),

h) Endurance,

j) Abnormal operation,

k) Stability,

m) Mechanical strength,

n) Construction,

p) Cord grip and cord guard,

q) Provisions for earthing connection,

r) Screws and connections,

s) Creepage distances and clearances,

t) Resistance to:

  i) heat, fire and tracking, and

  ii) rusting,

u) Finish,

v) Measurement of heating-up time,

w) Measurement of temperature distribution

x) Measurement of overswing temperature and heating up excess temperature,

y) Measurement of cyclic fluctuation of temperature of hottest point, and

z) Measurement of temperature drop under load.

34.3 Acceptance Tests

The following shall constitute the acceptance tests:

a) Protection against electric shock,

b) Input,

c) Temperature-rise,

d) Electrical insulation and leakage current at operating temperature,

e) Moisture resistance,

f) Insulation resistance and electric strength (after humidity treatment),

g) Earthing connection,

h) Heating-up time, and

j) Measurement of sole plate temperature.

34.4 Routine Tests

The following shall constitute the routine tests:

a) Protection against electric shock,

b) High voltage, and

c) Earthing connection.

35 TESTING EQUIPMENT REQUIRED FOR ELECTRIC IRON AS PER IS 366 : 1985

Test fingers and test pins complete with 50 V ac supply and indicator lamps.

Auto transformer, input 230 V, output 0-270 V.

Voltmeter, 0-300V ac, accuracy class 1·0.

Milli ammeter 0-3 mA, accuracy class 1·0, resistance of 2 000 ± 100Ω for leakage current test.

Wattmeter 0-1 500 W, accuracy class 1·0.

Wooden test corner, 25 mm thick plywood 2′ × 2′ × 2′.

Thermocouple with temperature gauge (digital) 0-300°C, least count 0·1°C.

Isolating transformer of unity ratio with a centre tap 230/250 V, 2 kVA.

High voltage tester, 0-5 kV, ac, 0·5 kVA.

Humidity chamber thermostatically controlled with hygrometer and thermometer of 0-100°C range.

Wooden inclined plane with an adjustment of 0-15°C with horizontal plane.

Impact test apparatus, spring-operated or pendulum type.

Cord grip test equipment.

Torque screw driver.

Vernier calipers or feeler gauges.

Step down transformer primary 220/230 V, secondary 12 V, current 30 A, *Min.*

Ammeter 0-30 A, accuracy class 1·0, voltmeter 0-1 V, accuracy class 1·0.

Thermostatically controlled electric oven, 0-200°C, least count 1°C.

Ball pressure test apparatus.

Drop test equipment.

Flexing test apparatus.

Tripod stand with four thermocouple and four temperature gauge(digital) for all temperature related test.

Tripod stand with one thermocouple and one temperature gauge (digital) for heating up time test.

BNF Jet test apparatus, stop-watch for checking electroplating thickness.

Corrosion resistance chamber for corrosion resistance test.

Flat file for adhesion test.

Measuring tape to measure length of supply cord.

Apparatus for measuring temperature drop under load.

Various chemicals for tests on resistance to rusting and electroplating.

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